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SCIENCE ABSTRACTS: SECTION A 2727–3627

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PHYSICS ABSTRACTS

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SECTION A OF SCIENCE ABSTRACTS

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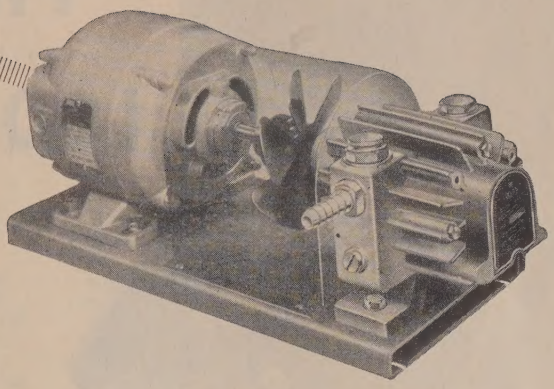

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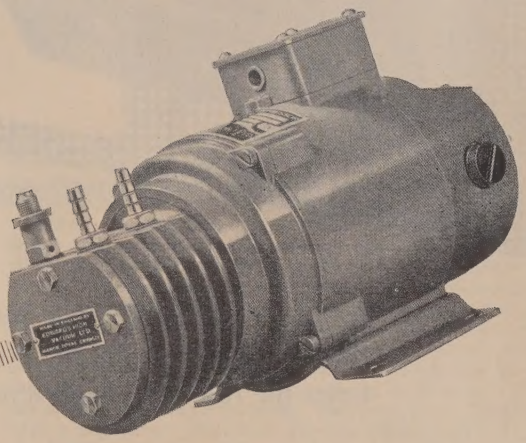

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PHYSICS ABSTRACTS

Volume 61 JUNE 1958 Number 726

MATHEMATICS

516.6 : 530.145

2727. FERMI COORDINATES. L.Ó Raifeartaigh.
Proc. Roy. Irish Acad. A, Vol. 59, No. 2, 15-24 (March, 1958).

Schouten and Struik (Einfuhrung in die Neueren Methoden der Differentialgeometrie. Vol. 1, Groningen: Noordhoff, 1936) have discussed Fermi coordinates for a subspace U_M ($M \geq 1$) immersed in a space V_N with symmetric affine connection Γ^i_{jk}. The present paper completes their treatment by giving an invariant necessary and sufficient condition for the existence of Fermi coordinates, and a more explicit treatment of their geometrical construction. In view of the physical importance of Fermi coordinates in connection with the vanishing of the energy pseudo-tensor (in field theory), the theory is given in detail. A.

517

2728. SOME REMARKS ON THE SYMBOLIC METHOD. O.Koníček.
Slaboproudý Obzor, Vol. 19, No. 2, 98-101 (1958). In Czech.

General properties of the Steinmetz symbolic method are stated in four theorems and it is pointed out that the complex numbers representing symbolic harmonic quantities should be distinguished from ordinary complex numbers. It is suggested that the symbolic complex numbers should be denoted by symbols of the type $\hat{Y}$, and that it is wrong to refer to them as vectors (a term "complex" is proposed for $\hat{Y}$). Application of the method to the solution of differential and integro-differential equations is formulated in five theorems and the concept of the impedance $\hat{Z}$ is introduced. When $\hat{Z} = 0$, the method is not applicable to the solution of the equations. R.S.Sidorowicz

517.3

2729. SOLID ANGLE CONTOUR INTEGRALS, SERIES, AND TABLES. A.V.Masket.
Rev. sci. Instrum., Vol. 28, No. 3, 191-7 (March, 1957).

The solid angle subtended at a point by any object is determined by the closed contour that outlines the "visible" boundary of the object from the point. By transformation of the double integral $\Omega = \iint \sin\theta d\theta d\varphi$ into a single integral over θ or φ, with limits determined by the contour and choice of axes, the solid angle may be simply represented in the important cases discussed as a contour integral. The integration was carried out on the high-speed digital computer ORACLE at Oak Ridge National Laboratory. Solid angle tables were prepared for the circular disk and the entire finite right-circular cylinder in terms of cylindrical coordinates. Each table contains in excess of 12 000 entries to six significant figures. A.

518.5 : 517.949 : 681.142

2730. MODERN COMPUTING METHODS.
Notes appl. Sci. Nat. Phys. Lab., No. 16, 129 pp. (1957).

These authoritative notes on the mathematical aspects of numerical work cover: the solution of simultaneous linear algebraic equations; the inversion of matrices and the determination of their latent roots and vectors; the determination of real and complex roots of polynomial equations; the theory of finite differences and its use in solving ordinary differential equations of boundary-value and initial-value types; the solution of hyperbolic partial differential equations by the method of characteristics; the solution of parabolic and elliptical partial differential equations; relaxation methods; and the construction of mathematical tables. A final chapter shows by examples the necessity of using a variety of techniques in the various stages of solving a problem. There are three appendices: the first, a full but not exhaustive 128-item bibliography; the second, an example of the use of the calculating machine Deuce; and the third, some notes on the mechanical differential analyser. G.A.Montgomerie

ASTRONOMY . ASTROPHYSICS

523.03 : 537.525

OBSERVATIONS OF EXPLOSIONS OF HIGH-SPEED PLASMA IN A MAGNETIC FIELD. See Abstr. 2346

523.11 : 530.12

2731. THE FORMATION OF NEBULAE IN RELATIVISTIC COSMOLOGY. W.B.Bonnor.
Ann. Inst. Poincaré, Vol. 15, No. 3, 158-72 (1957). In French.

The problem of the growth of condensations in point-source relativistic models is reviewed. Closed models are regarded as more favourable for condensations than open models, but the density fluctuations required to account for the formation of nebulae by the present time are much larger than those to be expected from classical statistical theory. This difficulty might be overcome in an Eddington–Lemaître model or in an oscillating model. R.A.Newing

523.12

2732. THE CALCULATION OF THE AGE OF THE ELEMENTS. A.H.W.Aten, Jr.
Physica, Vol. 23, No. 12, 1073-86 (Dec., 1957).

It is shown that if the known abundance ratio of thorium and uranium is taken into account, a fairly accurate value can be derived for the age of the elements, even with the existing uncertainty in the dependence of primary stabilized abundances on the atomic weight and in the abundances of the heaviest isotopes of thorium and uranium. The age of the elements turns out to be $6.25 \times 10^9 \pm 0.5 \times 10^9$ years. A.

523.14 : 523.164

2733. ON A NEW MECHANISM FOR THE GENERATION OF RELATIVISTIC ELECTRONS IN COSMIC SPACE. V.I.Veksler.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 2, 263-5 (1958). In Russian.

It is shown that the motion of a quasi-neutral mass of completely ionized plasma in a non-uniform magnetic field must be accompanied by the generation of relativistic electrons. This mechanism may partially account for the emission of radiowaves from cosmic objects. W.O.Lock

523.164.3

2734. EIGHTEEN-MEGACYCLE RADIATION FROM JUPITER. C.H.Barrow and T.D.Carr.
J. Brit. Astron. Assoc., Vol. 68, No. 2, 63-9 (Feb., 1958).

Radio observations of the planet Jupiter were made over a period of ten weeks at the beginning of 1957 using an eight-dipole aerial array. A statistical interpretation of the results indicates that the radio noise is due to two major localized sources having flux-densities greater than 8.5×10^{-20}/W m^{-2}(c/s)$^{-1}$, with a possible smaller source. On the basis of these observations the existence of a Jovian ionosphere with an electron density of the order of 10^6/cm^3 is suggested. The observations are compared with visual observations for the same period and with Shain's results (Abstr. 6298/1956). A.

523.164.32

2735. ON THE FINE STRUCTURE OF SOLAR BURSTS IN THE 200 Mc/s RANGE AND THEIR DRIFT IN FREQUENCY. Ø.Elgarøy.
Astrophys. Norveg., Vol. 6, No. 6, 55-74 (Jan., 1958).

High-speed records have been obtained simultaneously at 199 Mc/s and 200.5 Mc/s with a two-channel receiver at the Solar Observatory at Harestua, near Oslo. Observations were performed in the period between February and September 1957. An analysis of the records reveals that there often is a time-difference between corresponding pips on the two neighbouring frequencies. The time-difference Δt is defined as the difference $T_l - T_h$ between time of maximum intensity of a transient in the low- and the high-frequency channel. A histogram of the distribution of 2051 pairs of pips of different time-differences is given. In this material 48% of the pips occur first on the low frequency, 34% on the high frequency and 18% simultaneously. When the same active centre is followed for two or more days, the amount of pips which occurs first in the high-frequency channels decays with time. There is reason to think that during central meridian passage of active radio-noise areas, equal numbers of pips should be found with positive and negative time-differences. Possible interpretations of the observational results are discussed. A technical description of the equipment used is given in an appendix. A.

523.164.32 : 537.591

2736. THE EMISSIONS OF TYPE IV AND THE ORIGIN OF COSMIC RAYS ASSOCIATED WITH SOLAR FLARES.
A.Boischot and J.F.Denisse.
C.R. Acad. Sci. (Paris), Vol. 245, No. 25, 2194-7 (Dec. 16, 1957).
In French.

The general characteristics of solar bursts of type IV, observed on metre wavelengths, find an explanation in terms of electrons emitted from the flare with relativistic energies in the presence of a magnetic field, giving synchrotron radiation. Typical conditions are $\sim 10^{32}$ electrons with mean energy 3 MeV in a magnetic field of 1 gauss. The relationship between this type of burst and the emission of cosmic radiation by the sun is discussed.

M.W.Ovenden

523.164.34

2737. ON SHORT PERIODIC VARIATIONS IN SOLAR NOISE STORMS ON 200 Mc/s. Ø.Hauge.
Astrophys. Norveg., Vol. 6, No. 5, 43-54 (Jan., 1958).

19 days with enhanced solar radiation on 200 Mc/s in June, July and August 1955 are investigated by an auto-correlation method in a search for short-periodic variations with repetition times between $7\frac{1}{2}$ and 90 minutes in the flux intensity of the base level. Some noise storms show periodic variations with repetition times differing from day to day, while in other noise storm intervals no periodic variations are found at all. The burst-generating areas seem to retain the feature of showing short-periodic variations in radio emission for long time intervals. Shorter periods seem mostly to occur at higher flux intensities. No connection seems to exist between the lengths of the periods and (a) the noise storm variability factor, and (b) the frequency interval on which the noise storm is registrated. Short periodic changes in radio emission seem to be associated with areas on the sun giving strong or moderate coronal emission on 5303 and 6374 A. A.

523.164.4

2738. ON A FEATURE OF GALACTIC RADIO EMISSION.
H.Tunmer.
Phil. Mag. (Eighth Ser.), Vol. 3, 370-6 (April, 1958).

Observations of the intensity distribution of radio emission have shown a bright belt approximately normal to the Galactic plane and passing through the anti-centre. An explanation is suggested in terms of the highly anisotropic radiation from relativistic electrons moving in the magnetic field of the local spiral arm. This suggestion avoids the supposition that the sun is in a special position in the Galaxy. A.

523.164.85 : 523.5

2739. A RADIO ECHO METHOD OF METEOR ORBIT DETERMINATION. J.C.Gill and J.G.Davies.
Monthly Not. Roy. Astron. Soc., Vol. 116, No. 1, 105-13 (1956).

A radio-echo system using three receivers spaced on the ground by 4 km has been used to determine the orbits of individual meteors. About 200 orbits can be calculated from the meteor echoes photographed during a 24 hour period of observation. An analysis of Geminid meteors observed in 1954 indicates that the accuracy obtainable is limited to about ±2 km/sec in velocity by atmospheric deceleration, and to $\pm 3^0$ in radiant position by turbulent winds in the meteor region. A.

523.59

2740. THE ZODIACAL LIGHT AND THE NATURE OF INTERPLANETARY GAS. D.E.Blackwell.
Observatory, Vol. 77, 187-91 (Oct., 1957).

Observational data on the brightness of the zodiacal light and its spatial and temporal variations are reviewed, and discussed in relation to Biermann's recent (1957) suggestion that the polarized component of scattered sunlight in the zodiacal light is due not to the presence of an interplanetary gas but to corpuscular radiation emitted by the sun. From considerations of particle density in solar streams it is concluded that the radiation from these cannot possibly contribute the required electron density. The whole problem must remain open until more precise measures of zodiacal light brightness are available. D.R.Barber

523.67

2741. POLARIZATION OF THE INTEGRATED LIGHT OF COMET AREND–ROLAND, 1956h. D.R.Barber.
Nature (London), Vol. 181, 760-1 (March 15, 1958).

Photographs of the comet were taken on April 29-30, 1957, through a "Polaroid" filter, whose axis was aligned first parallel to, then perpendicular to, the radius vector to the sun. The percentage polarization found was 41 ± 5% in the brightest part of the coma, and 51 ± 5% in the inner tail, 4' of arc from the coma. These results agree with those found by Richter (1957) for the same comet when using a polarizing filter. D.R.Barber

523.72 : 532.5 : 538.3

HEATING OF THE SOLAR ATMOSPHERE. See Abstr. 2420

523.746 : 523.76

2742. ON THE DEPENDENCE OF THE MAGNETIC FIELD STRENGTH OF SUNSPOTS ON THEIR AREAS IN RELATION TO THE SOLAR CYCLE. E.Jensen and T.S.Ringnes.
Astrophys. Norveg., Vol. 6, No. 1, 1-16 (Sept., 1957).

The problem of determining how the magnetic field strength of sunspots depends upon their areas, as treated by Houtgaat and van Sluiters (1948), is reconsidered. The Mount Wilson magnetic observations and Greenwich observations of areas for the years 1917-1924 are used. The discussion is restricted to single regular spots, with total areas larger than 60 millionths of the solar hemisphere. Only observations in a central zone of the solar disk are included. Two ways of approach are considered, in that the magnetic field is expressed either with the total spot area, or with the umbra area as independent variable. In both cases systematic changes with the solar cycle are found in the formula connecting the area and the field strength. Reasons are given for preferring the umbra area as a variable instead of the total area. The connection between the changes found and other solar phenomena is briefly discussed. A.

523.746

2743. THE VARIATION OF THE PENUMBRA–UMBRA RATIO OF REGULAR SUNSPOTS WITH HELIOCENTRIC LATITUDE.
E.Jensen and T.S.Ringnes.
Astrophys. Norveg., Vol. 6, No. 4, 33-42 (Dec., 1957).

The dependence upon the heliocentric latitude of the ratio (q) between the over-all radius of sunspots and the umbra radius is investigated. By selecting the observations special precautions were taken to avoid the effects due to a changing distance from the centre of the solar disk (Wilson effect). Curves are given showing the ratio q of regular spots of medium size as a function of latitude during sunspot maxima and sunspot minima for the southern and northern hemisphere separately and for both hemispheres combined. A slight effect is found in the sense that q is small at higher latitude. However, this effect cannot explain the changes in q from sunspot maximum to sunspot minimum. It is concluded that upon the pronounced variation of q with phase in the solar cycle, which is a global effect, there is superposed a much less pronounced change with heliocentric latitude. A.

523.75 : 523.164.32

2744. ON THE CORRELATION BETWEEN SOLAR FLARES AND RADIO BURSTS. E.Tandberg-Hanssen.
Astrophys. Norveg., Vol. 6, No. 2, 17-25 (Oct., 1957).

Some 700 cases of time coincidences between flares and (presumably randomly polarized) radio bursts on 200 Mc/s were analysed to study the correlation between flare importance and radio bursts. It is found that as a general rule the correlation increases greatly with the importance of the flares. Bright flares occur, however, at times when there is no indication of excess radio radiation, and strong radio bursts are not infrequently observed at times when there is no excess H_α-radiation. One is led to conclude that radio bursts are

not to be considered as flare-induced phenomena, but that flares and radio bursts are but two manifestations of a common disturbance.
A.

523.752

2745. RELATION BETWEEN THE BASE AND THE HEIGHT OF PROMINENCES. A.K.Das and K.Sethumadhavan.
Kodaikanal Obs. Bull.,No. 127, 215-23 (rec. Dec., 1957).

From a comprehensive study of 188 quiescent arched K-prominences photographed at Kodaikanal, 1908-1940, the most frequent form observed (whether as dark markings on the disk, or bright prominences at the limb) appears to be the semicircular arch with base/height ratio of 2 : 1. The ratio 3 : 1 is conspicuous also for disk markings, indicating the cycloid arch to be a fairly common form of quiescent prominence. D.R.Barber

523.872

2746. THE INFORMATION CONTENT OF STELLAR SPECTRA FROM PHOTOGRAPHIC AND PHOTOELECTRIC OBSERVATIONS. H.Siedentopf.
S.B. Heidelberg. Akad. Wiss. (math. nat. Kl.), 1956-57, No. 4, 385-9. In German.

Examples are cited to illustrate the application of information theory to photographic and photoelectric methods of spectrophotometry. D.R.Barber

525.3

2747. APSIDAL MOTION OF AN IGY SATELLITE ORBIT. L.Blitzer.
J. appl. Phys., Vol. 28, No. 11, 1362 (Nov., 1957).

Correction to Blitzer, Weisfeld and Wheelon (Abstr. 1036/1956). The advance of the line of apsides is now given, relative to the moving node, by

$$\frac{2\pi J R^2}{a^2(1-e^2)^2}\left(2-\tfrac{5}{2}\sin^2 i\right)$$

per revolution (where $J = 1.637 \pm 10^{-3}$ is the coupling constant). For inclinations greater than 63.5°, the apsidal motion becomes retrograde. M.W.Ovenden

523.877 : 539.17

NUCLEAR REACTIONS IN STARS. BUILDUP FROM HELIUM.
See Abstr. 2594

525.35

2748. ON THE PROGRESSIVE VARIATION OF THE ROTATION OF THE EARTH. A.Stoyko and N.Stoyko.
C.R. Acad. Sci. (Paris), Vol. 246, No. 2, 235-7 (Jan. 13, 1958). In French.

Comparison of the caesium frequency standard at the N.P.L. with the definitive time of the Bureau International de l'Heure shows an increase in the length of the day between 1955 June and 1957 September equal to 31.93 ± 0.61 μsec per month after elimination of seasonal changes (Abstr. 5017/1957). Observations with an ammonia frequency standard at Tokyo Observatory lead to a value of 36.76 μsec per month over the period 1956.19 to 1957.12.
A.H.Cook

529.1

2749. GEODETIC ANNUAL VARIATION OF THE SIDEREAL DAY. A.D.Fokker.
Physica, Vol. 23, No. 12, 1100-2 (Dec., 1957).

Owing to the geodetic precession of parallel axes, according to Einstein's theory of gravitation, the sidereal day will be shorter than the proper terrestrial day. The difference will amount to $\frac{3}{2}$ m/r of the difference between mean solar day and sidereal day (237 sec) where m is the gravitation parameter of the sun, expressed as a length (1.47 km) and r the radius of the earth's orbit (1.5×10^8 km). The earth's orbit being an ellipse ($1/r = (1 + e\cos\varphi)/a$) with eccentricity e = 1/60, the geodetic fluctuation amplitude in the difference of sidereal and proper terrestrial day will amount to 237 sec. $e \cdot \frac{3}{2}$ m/a = 6 mμsec. In the spring the sidereal clock will be 3.44 μsec fast, in the autumn as much slow. Recent data on the seasonal irregularities of the earth's rotation point to a fluctuation of about 27 millisec. A.

PHYSICS

FUNDAMENTALS

530.12

2750. GRAVITATIONAL WAVES IN GENERAL RELATIVITY. W.B.Bonnor.
Ann. Inst. Poincaré, Vol. 15, No. 3, 133-45 (1957). In French.

In the first approximation to the field equations, as is known, plane gravitational wave solutions may be found for which only the purely transverse waves cannot be transformed away. For cylindrical waves the Einstein–Rosen solution has a singularity in the metric, the source of the waves being located along the symmetry axis. Applying a method using complex constants developed by Synge to obtain regular solutions to Maxwell's equations, new solutions to the cylindrical equations are found, which are everywhere regular (in particular, at infinity). It is shown that Weyl's solution for the static problem of two particles can also be transformed into the same type of non-singular solution. Exact non-singular plane wave solutions found by Robinson (unpublished) are described. The significance of these curious regular solutions, which appear to provide no sources for the gravitational waves, is discussed in detail. M.J.Kearsley

530.12

2751. THE PROBLEM OF MOTION IN GENERAL RELATIVITY AND IN EINSTEIN'S UNIFIED FIELD THEORY. A.Papapetrou.
Ann. Inst. Poincaré, Vol. 15, No. 3, 173-203 (1957). In French.

It is shown that the equations of motion may be deduced from the field equations in a theory combining many fields (unified or not) provided that one is the gravitational field and that the equations of the other fields are such that the total Lagrangian only contains the $g_{\mu\nu}$ (of the Riemann space) and the potentials of the fields considered. Use of the dynamical equations with the Fock method simplifies calculations in problems of astronomical motion and the motion of test particles, enabling the structure of the latter to be taken into account. The equations of motion are obtained explicitly. The hypotheses in the methods of Fock, and Einstein–Infeld–Hoffmann are compared. Motion in Einstein's unified field theory with $g_{\mu\nu}$ non-symmetric is described and the difficulties implicit in the definitions of current and charge density by Infeld and Callaway are discussed in detail.
M.J.Kearsley

530.12

2752. THE GRAVITATIONAL EFFECT OF SPIN. O.Costa de Beauregard.
C.R. Acad. Sci. (Paris), Vol. 246, No. 2, 237-40 (Jan. 13, 1958). In French.

Inductive arguments involving magnetism and Mach's principle are introduced in support of the existence of the effect, and the possibility of an observational test is considered. $W^i = U^i - V^i$ is now interpreted as a velocity induced by the spin field, and a modified derivation is given for some results obtained previously (see Abstr. 1471/1958). R.A.Newing

530.12

2753. THE FIBRE SPACE OF AN AFFINITY AND ITS FUNDAMENTAL ROLE IN THE EINSTEIN–SCHRÖDINGER UNIFIED THEORY. F.Maurer-Tison.
C.R. Acad. Sci. (Paris), Vol. 246, No. 2, 240-3 (Jan. 13, 1958). In French.

The linear connection and the fundamental tensor of the relativistic theory are shown to define an infinitesimal connection on a fibre space. This latter connection is called "coaffine", and the relativistic field equations are interpreted as a condition that the geodesics of this connection shall coincide with those of an associated connection. R.A.Newing

530.12

2754. ZERO CURVATURE TENSOR IN EINSTEIN'S UNIFIED FIELD THEORY. M.Wyman and H.Zassenhaus.
Phys. Rev., Vol. 110, No. 1, 228-36 (April 1, 1958).

In classical relativistic gravitational theory a zero curvature

tensor is characteristic of the flat space-time of special relativity. However this result is not valid in Einstein's forms of unified field theory. This paper derives and discusses all solutions of Einstein's unified field equations that result from a zero curvature tensor. By obtaining a rather extensive class of rigorous solutions it was hoped that a detailed examination of their physical interpretations might clarify many of the ambiguities that exist, in the theory, at the present time. This hope was not realized as the detailed examination served to show that the present formulations of Einstein's unified field theories cannot be considered complete. A.

530.12

2755. DYNAMICS OF A LATTICE UNIVERSE BY THE SCHWARZSCHILD-CELL METHOD. R.W.Lindquist and J.A.Wheeler.
Rev. mod. Phys., Vol. 29, No. 3, 432-43 (July, 1957).

It is supposed that the zones of influence of a number of mass concentrations may each be represented approximately as a spherical cell, and the actual gravitational field in each cell is replaced by a static Schwarzschild field for a point mass. Equations of motion are determined by dynamical conditions at the boundaries of the cells. These ideas are applied to the dynamics of a system of equal masses arranged in a regular lattice in a closed space. A comparison hypersphere is introduced and equations of motion are derived from the conditions that the boundary of a cell shall be tangential to the hypersphere, and the solid angle subtended by a cell on the hypersphere shall not change with time. The equation for the cell radius is found to be identical with that of a freely falling test particle, and the time variation of the radius of the hypersphere is essentially the same as that for the radius of an ideal Friedmann universe.

R.A.Newing

530.12 : 523.11

2756. REMARK ON COSMOLOGICAL MODELS.
R.W.Bass and L.Witten.
Rev. mod. Phys., Vol. 29, No. 3, 452-3 (July, 1957).

A general theorem concerning the topology of space-time manifolds is considered. From the construction of a continuous, nowhere-vanishing, irrotational vector field, it can be asserted that the manifold is either non-compact, or not simply-connected.

R.A.Newing

530.12

2757. REALITY OF THE CYLINDRICAL GRAVITATIONAL WAVES OF EINSTEIN AND ROSEN. J.Weber and J.A.Wheeler.
Rev. mod. Phys., Vol. 29, No. 3, 509-15 (July, 1957).

It is noted that the waves produce a non-zero curvature, which is not removable by coordinate transformations. It is also argued that the vanishing of the energy–momentum pseudo tensor does not imply zero energy for unbounded waves. In a discussion of the motion of a test particle under the action of a wave or pulse, the analogies are stressed with the case of a charged particle subject to the action of an electromagnetic wave. R.A.Newing

530.145

2758. A SOLUBLE RELATIVISTIC FIELD THEORY.
W.E.Thirring.
Ann. Phys. (New York), Vol. 3, No. 1, 91-112 (Jan., 1958).

The theory of a self-coupled spinors field with $L = \lambda\bar{\psi}\psi\bar{\psi}\psi$ is solved in one space and one time dimension. A representation of the eigenstates of the energy is given. Some observable quantities are calculated and found to be finite after renormalization. They can be expanded in powers of λ with a finite radius of convergence. A.

530.145

2759. STABLE EXCITED STATES OF RELATIVISTIC FLUID MASSES IN ROTATION. P.Hillion and J.P.Vigier.
C.R. Acad. Sci. (Paris), Vol. 246, No. 3, 394-6 (Jan. 20, 1957).
In French.

Recent causal theories have involved the motion of a medium composed of rotating fluid droplets. Two distinct points, the mass centre X and the "matter centre" Y, are defined for such a droplet and an intrinsic angular momentum tensor with respect to Y is introduced. It is suggested that it may be possible to describe the fundamental particles in terms of the excited states of such droplets.

R.A.Newing

530.145

2760. SPIN, STATISTICS, AND THE TCP THEOREM.
J.Schwinger.
Proc. Nat. Acad. Sci. U.S.A., Vol. 44, No. 2, 223-8 (Feb., 1958).

Using the author's formulation (Abstr. 7430/1953) of quantum field theory and assuming relativistic invariance and the existence of a vacuum state, both the TCP theorem (W.Pauli in "Niels Bohr and the development of physics". New York: McGraw-Hill, 1955) and the connection between spin and statistics are proved. Use is made of Hermitean fields. J.C.Taylor

530.145

2761. ON THE CONSERVATION OF COMBINED PARITY.
V.G.Solov'ev.
Zh. éksper. teor. Fiz., Vol. 33, No. 2(8), 537-8 (1957). In Russian.

The hypothesis is put forward that all interactions are invariant under "combined inversion" IC, and not necessarily under I and C separately. Considering renormalizable interactions only, it is found that the requirement of gauge-invariance ensures that electromagnetic interactions conserve I and C separately, whereas the pion–nucleon interaction may contain terms which violate reflection-invariance. Such terms must be small since double scattering experiments with nucleons give an "up-down" asymmetry of less than 1%. [It has been subsequently pointed out by the author and independently by Feinberg and by Gupta that the parity-violating terms in the pion–nucleon interaction also violate charge-independence. On the other hand, the degree of parity violation in nuclear interactions has recently been shown to be less than 10^{-7} (Abstr. 1978/1958)]. See also the following abstract. P.K.Kabir

530.145

2762. THE HYPOTHESIS OF CONSERVATION OF COMBINED PARITY ONLY IN STRONG, ELECTROMAGNETIC AND WEAK INTERACTIONS. V.G.Soloviev.
Nuclear Phys., Vol. 6, No. 4, 618-24 (April [2], 1958).

The hypothesis is considered that only combined parity IC is conserved in strong, electromagnetic and weak interactions. It is demonstrated that the hypothesis is not inconsistent with available experimental data. However, more precise polarization experiments are required for a proof that the hypothesis is correct. It is shown that gauge-invariance in quantum electrodynamics and isobaric invariance in pseudoscalar meson theory lead to invariance of renormalizable interaction Lagrangians under space reflection I. Renormalizable and isobarically-invariant Lagrangians for the interaction between K-mesons and baryons are obtained which are invariant under the operation IC but not under the operation I. See also the preceding abstract. A.

530.145

2763. OBSERVABLES IN SINGULAR THEORIES BY SYSTEMATIC APPROXIMATION. E.Newman and P.G.Bergmann.
Rev. mod. Phys., Vol. 29, No. 3, 443-9 (July, 1957).

The failure of general relativistic theory to permit the prediction of ordinary field variables by integration is associated with the "singular" character of its action principle (Abstr. 7118/1956). A method of successive approximation, similar to that of Einstein-Infeld-Hoffmann, is developed that permits the construction of a complete set of observables. R.A.Newing

530.145

2764. RELATIVISTIC EQUATION FOR THE DISTINGUISHED COMPONENT OF THE STATE VECTOR. K.L.Nagy.
Nuovo Cimento, Vol. 8, No. 1, 32-8 (April 1, 1958).

An integro-differential equation for the distinguished component of the state vector is deduced from the Schwinger–Tomonaga equation of the interacting fields. It is proved that this equation is completely equivalent to a differential equation. These equations are the relativistic generalizations of those of Królikowski and Rzewuski (Abstr. 1886/1957), the interaction picture and arbitrary space-like surfaces being used. As an example, the dressing and the oscillation of a bare V-particle in the Lee model is studied. A.

530.145

2765. ON THE QUANTIZATION OF FERMION FIELDS WITH ZERO MASS. C.G.Bollini.
Nuovo Cimento, Vol. 8, No. 1, 39-47 (April 1, 1958).

The formulation of quantum field theory for massless tensor fields given in a previous paper, is extended to fermion fields with zero mass. The fermion field, which in the Rarita–Schwinger formalism is represented by a tensor spinor, is expressed in terms of simple Dirac spinors. These Dirac spinors are free components of the field and the usual anticommutation relations are imposed on them. The corresponding anticommutation relations of the field components are given. They are compatible with the supplementary conditions. A.

530.145

2766. PROOF OF DISPERSION RELATIONS IN QUANTIZED FIELD THEORIES. H.J.Bremermann, R.Oehme and J.G.Taylor.
Phys. Rev., Vol. 109, No. 6, 2178-90 (March 15, 1958).

The problem of deriving dispersion formulae is reduced to that of the analytic continuation of all functions which are regular in certain domains in the space of several complex variables. The dispersion relations for pion–nucleon scattering are proven for momentum transfers in the centre-of-mass system which are smaller than $2\sqrt{2}M_\pi$. This limit can be improved by further analytic continuation. By using causality and spectral conditions the dispersion formulae for forward nucleon–nucleon scattering could be derived only under the unphysical condition $M_\pi > (\sqrt{2} - 1)M_N$. The possibility cannot be excluded that this restriction is weakened by taking into account all symmetry properties of the complete four-body Green's function. The situation is similar for the representation of the meson–nucleon vertex function taken on the mass shell of the nucleons. In this case an example of Jost shows that the validity of the dispersion formula cannot be guaranteed on the basis of causality, spectrum and symmetry properties. A.

530.145 : 538.3

REMARKS ON THE MEASURABILITY OF ELECTROMAGNETIC FIELDS. See Abstr. 2416

530.145

2767. A THEORY OF THE FUNDAMENTAL INTERACTIONS. J.Schwinger.
Ann. Phys. (New York), Vol. 2, No. 5, 407-34 (Nov., 1957).

Assuming conventional field theory and using only Hermitean fields, the simplest kinds of internal degrees of freedom a particle can have must correspond to the 2, 3, 4, ... dimensional Euclidian rotation groups. These three seem to be realized in nature, some interactions having the full 4-dimensional symmetry, some having less. All interactions are postulated to have dimensionless coupling constants. In order to be coupled with pions, baryons have to have a further doubling of the number of their components. A singlet, scalar meson σ might exist, permitting some interplay between internal and Lorentz degrees of freedom. Nucleons and cascade particles may have opposite parity. Leptons are included in this scheme as an isotriplet. The σ-meson is responsible for the muon mass. The photon is also part of a triplet, its (heavy) charged companions being intermediaries in the weak interactions. The neutrino has a four-component spinor, and there is lepton conservation. Beta decay is supposed to contain both vector and tensor interactions. J.C.Taylor

530.145

2768. ON THE THEORY OF β-INTERACTION. H.Koppe.
Nuclear Phys., Vol. 3, No. 4, 585-91 (June, 1957). In German.

It is shown that non-conservation of parity in β-interaction cannot lead to an electric dipole moment of fermions, if the coupling constants are real; and that a coupling with $(1 + i\gamma_5)$ leads to vanishing magnetic and electric moments of the neutrino. A.

530.145 : 539.12

2769. A POSSIBLE TEST OF THE PRIMARITY OF THE WEAK INTERACTIONS COMPRISING LEPTONS. S.Oneda.
Nuclear Phys., Vol. 4, No. 1, 21-8 (Aug., 1957).

A careful analysis of the charge properties of the secondary particles in the K-meson decays comprising leptons is proposed. The occurrence of the modes $K^+ \to \pi^+ + \pi^+ + \mu^-(e^-) + \nu$ and $K^0 \to \pi^+ + \mu^-(e^-) + \nu$ should give good information on the character of the primary weak interactions. Also the importance of the investigation of the alternative decays of hyperons into leptons is stressed. A.

530.145

2770. POSSIBLE MODEL FOR STRONG INTERACTIONS. S.Barshay.
Phys. Rev., Vol. 109, No. 6, 2160-2 (March 15, 1958).

A model is considered for the strong interactions of pions, K-mesons, nucleons, and hyperons. A system of interactions is postulated and several features of the experimental situation are discussed from the new viewpoint. No restrictions are placed upon the coupling parameters involved other than that they characterize a system of strongly interacting particles. A.

530.145

2771. THE STATIONARY STATES OF INTERACTING FIELDS. W.R.Frazer and L.van Hove.
Physica, Vol. 24, No. 2, 137-54 (Feb., 1958).

As an application of a time-independent perturbation formalism developed earlier for systems with many degrees of freedom, the general perturbation expressions are given in terms of diagrams for the exact stationary states of interacting fields. The physical vacuum is obtained by applying to the bare vacuum the exponential of an operator simply expressed in terms of connected diagrams. For the states with one or more physical particles expressions are found in the form of suitably defined creation operators applied to the physical vacuum. The incoming and outgoing parts of a scattering state are analysed in terms of products of physical particle creation operators, the connection being given by the S-matrix. Some remarks are made on renormalization. For electrodynamics in particular the ratio of renormalized to unrenormalized fine-structure constants is shown to have a simple probabilistic interpretation: it is the probability to find the bare one-photon state in the physical one-photon state of vanishing momentum, divided by the probability to find the bare vacuum in the physical vacuum. A.

530.145

2772. EXACTLY RENORMALIZABLE MODEL IN QUANTUM FIELD THEORY. I. THE DIAGRAM ANALYSIS. T.W.Ruijgrok.
Physica, Vol. 24, No. 3, 185-204 (March, 1958).

A simple model is considered for the interaction of a boson field with infinitely heavy nucleons, susceptible of an exact determination of the physical nucleon states and of the renormalization constants. The model is an extension of the Lee model as well as of the neutral scalar field in scalar interaction with heavy nucleons. The diagram analysis of the S-matrix and of the renormalization is carried out. The renormalized coupling constants remain different from zero for infinite cut-off. In this limit the theory becomes essentially equivalent to the neutral scalar field in interaction with heavy nucleons; it then gives vanishing boson–nucleon scattering but non-vanishing nucleon–nucleon interaction, the latter in contrast to the Lee model. A.

530.145

2773. EXACTLY RENORMALIZABLE MODEL IN QUANTUM FIELD THEORY. II. THE PHYSICAL-PARTICLE REPRESENTATION. T.W.Ruijgrok.
Physica, Vol. 24, No. 3, 205-13 (March, 1958).

For the simplified model of quantum field theory discussed in the preceding abstract it is shown how the physical particles can be properly described by means of the so-called asymptotically stationary (a.s.) states. It is possible by formulating the theory in terms of these a.s. states to express it entirely in terms of renormalized quantities and convergent integrals. A.

530.145

2774. NEW SYMMETRY PROPERTY AND NEW CONSERVATION RELATIONS FOR THE DIRAC FIELD. T.Takabayasi.
C.R. Acad. Sci. (Paris), Vol. 246, No. 1, 64-6 (Jan. 6, 1958). In French.

These are found in a new formalism for the Dirac field, described in terms of an "internal" Lorentz 4-vector, a scalar and a pseudoscalar local field. G.H.Burkhardt

530.145

2775. A NEW WAY OF ESTABLISHING THE MATHEMATICAL EXPRESSION OF HUYGENS' PRINCIPLE IN THE DIRAC ELECTRON THEORY. Phan-Van-Loc.
C.R. Acad. Sci. (Paris), Vol. 246, No. 3, 388-90 (Jan. 20, 1958). In French.

530.145

2776. ON SPACE, TIME AND WORLD REVERSALS IN THE THEORY OF DIRAC SPINORS. III. CHOICE OF FUNDAMENTAL REPRESENTATIONS DETERMINED BY THE NATURE OF THE SPINOR. J.Winogradzki.
C.R. Acad. Sci. (Paris), Vol. 246, No. 3, 397-9 (Jan. 20, 1958). In French.

Continuation of Abstr. 1505 (1958).

530.145 : 539.12

2777. TWO-COMPONENT THEORY OF THE NEUTRINO AND K-MESON DECAYS COMPRISING TWO NEUTRINOS. S.Oneda.
Nuclear Phys., Vol. 3, No. 4, 598-605 (June, 1957).

The K-meson decays comprising two neutrinos are investigated by using a two-component theory of the neutrino. The results are closely connected with the question whether the conservation of fermion numbers is valid or not. They will also give some information on the character of the primary weak interactions. A.

530.145

2778. RELATION OF CHARGE INDEPENDENCE AND BARYON CONSERVATION TO PAULI'S TRANSFORMATION. F.Gürsey.
Nuovo Cimento, Vol. 7, No. 3, 411-15 (Feb. 1, 1958).

A four-component spinor for a massless neutrino has twice the

minimum number of components necessary to represent the proper Lorentz group. This degeneracy is expressed by a four-parameter group, discovered by Pauli (Abstr. 8397/1957). Similarly, protons and neutrons together have twice the minimum number of components for a massive particle, and are associated with the isotopic and baryon-number group. It is shown that the Dirac equations for proton and neutron can be written as two coupled equations, each of which is separately invariant under a four-parameter group; thus exhibiting a formal similarity between the isotopic and Pauli groups.

J.C.Taylor

530.145

2779. ON FERMIONS AND REFLECTIONS. S.A.Wouthuysen.
Proc. K. Ned. Akad. Wetensch. B, Vol. 61, No. 1, 54-62 (1958).

Non-conservation of parity in weak fermion-interactions is interpreted by the following suggestion: multiplication of a free Dirac field by $e^{i\lambda\gamma^5}$ (λ real) leads to a change in the space-inversion property and this does not make any difference for free particles; but for interacting fermions, if the fields have different λ's [named here reflection parameter], the interaction will, in general, exhibit a lack of reflection invariance. Therefore it is proposed to ascribe to each spin-$\frac{1}{2}$-particle two quantities: its mass value and a reflection parameter λ. One requires further that the lack of reflection invariance is only due to the differences in the reflection parameters of the interacting fermions. This can be formulated in a group-theoretical language by using a 6-dimension formalism [the two added dimensions refer to the mass vector (m cosh λ, m sinh λ)] where the equations of motion and supplementary condition are the analogues in 6-dimensions of the relations used in 4-dimensions for a 2-component mass-less field. By a proper choice of the λ's, one obtains the usual two-component theory and: (1) in β-decay $C_S = -C_T$ and $C_A = C_V(|C_S|)/(|C_V|)$ = (electron mass)/(nucleon mass); (2) in μ-decay: only (V ± A) coupling. The author indicates that the isotopic-spin formalism (1) can be incorporated in this scheme. See also preceding abstract.

J.Lascoux

530.145

2780. MASS SELECTION RULES IN THE BILOCAL THEORY. I. E.Minardi.
Nuovo Cimento, Vol. 7, No. 5, 715-17 (March 1, 1958).

A rule is suggested to restrict the number of particle masses predicted by the author's theory (Abstr. 8031/1954; 3953/1957).

J.C.Taylor

530.145

2781. MASS SELECTION RULES IN THE BILOCAL THEORY. II. E.Minardi.
Nuovo Cimento, Vol. 7, No. 6, 898-900 (March 16, 1958).

An internal quantum number appearing in the author's theory (Abstr. 4815/1956) is identified with strangeness. J.C.Taylor

530.145

2782. HIGHER ORDER SPINOR LAGRANGIANS.
T.W.B.Kibble and J.C.Polkinghorne.
Nuovo Cimento, Vol. 8, No. 1, 74-83 (April 1, 1958).

Certain higher-order spinor Lagrangians arise naturally in an attempt to write a recent theory of Feynman and Gell-Mann (Abstr. 507/1958) in conventional terms. Their quantization is investigated together with the possible forms of interactions. The theory that seems closest in spirit to that of Feynman and Gell-Mann leads to only a pseudovector interaction with pseudoscalar mesons and a Fermi interaction that is a mixture of A and V. A.

530.145

2783. ON FOUR-DIMENSIONAL ISOBARIC SPIN FORMALISMS.
P.W.Higgs.
Nuclear Physics, Vol. 4, No. 2, 221-3 (Aug.[2], 1957).

It is shown that the use of a four-dimensional isobaric spin space with an indefinite metric is inconsistent with the probability definitions of quantum mechanics. A.

530.145

2784. THE ISOMERISM OF ELEMENTARY PARTICLES.
H.Umezawa and A.Visconti.
Nuclear Physics, Vol. 4, No. 2, 224-33 (Aug.[2], 1957).

Weak interactions are discussed from the point of view of the isomerism of elementary particles. A generalized gauge transformation is introduced to discuss the isomerism of the neutrino. A possible formulation for the isomerism of particles with finite masses is also pointed out. A.

530.145 : 539.12

2785. ELECTROMAGNETIC STRUCTURE OF THE NUCLEON IN LOCAL-FIELD THEORY.
G.F.Chew, R.Karplus, S.Gasiorowicz and F.Zachariasen.
Phys. Rev., Vol. 110, No. 1, 265-76 (April 1, 1958).

In analogy to the dispersion-relation method for scattering, the description of nucleon electromagnetic structure by local-field theory is discussed in terms of mass-spectral representations for the form-factors. The existence of such representations is made plausible although not proved, and it is shown that the spectral distribution functions are related to scattering amplitudes on the mass shell but sometimes in a nonphysical region. It is argued that the main contributor to the magnetic moment structure in the spectral distribution must be the two-pion state, and an attempt is made to evaluate this contribution in terms of the known behaviour of pion–nucleon scattering. A semiquantitative calculation yields results in reasonable agreement with experiment. It is emphasized that the large observed charge radius of the proton does not imply the dominance of the two-pion state in the charge structure. Thus it is not impossible that higher mass configurations supply the isotopic scalar charge needed to explain the small neutron–electron interaction. A.

530.145

2786. A CONSISTENCY CONDITION FOR ELECTRON WAVE FUNCTIONS. C.J.Eliezer.
Proc. Cambridge Phil. Soc., Vol. 54, Pt 2, 247-50 (April, 1958).

It is shown how far the Dirac wave-function of an electron in an external electromagnetic field determines that field.

J.C.Taylor

530.145

2787. ELEMENTARY RELATIVISTIC WAVE MECHANICS OF SPIN 0 AND SPIN $\frac{1}{2}$ PARTICLES. H.Feshbach and F.Villars.
Rev. mod. Phys., Vol. 30, No. 1, 24-45 (Jan., 1958).

In this review the points common to the theories of the Dirac and Klein–Gordon equations are stressed and questions of interpretation are emphasized. Following the discussion of the relation of the single particle theory to the quantum-field formalism in the external field approximation, the neutral particle theory is formulated.

W.A.Hepner

530.145

2788. CAUSALITY AND THE DISPERSION RELATION: S-MATRIX FOR KLEIN–GORDON AND DIRAC FIELDS.
J.M.Knight and J.S.Toll.
Ann. Phys. (New York), Vol. 3, No. 1, 49-66 (Jan., 1958).

The causality condition is used to derive analytic properties and dispersion relations for the S-matrix $S(\omega)$ for the case of unquantized Klein–Gordon and Dirac fields interacting with a fixed spherically symmetric scatterer of finite radius. It is shown that $S(\omega)e^{2i\omega a}$ as a function of the energy ω is analytic and bounded in the upper half ω-plane, where a is the radius of the scatterer. An infinite sequence of scattering amplitudes which satisfy a dispersion relation is given in terms of the elements of the S-matrix. The real part of the S-matrix is expressed in terms of its imaginary part and a set of constants by means of the dispersion relation. A.

530.145 : 539.12

2789. DISPERSION RELATIONS IN THE CASE OF WEAK INTERACTIONS. N.N.Bogolyubov, S.M.Bilen'kiĭ and A.A.Logunov.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 5, 891-3 (1957). In Russian.

It is shown that, for fixed nucleon recoil, the energy dependence of the differential cross-section for the process

$$\mu + p \rightarrow n + \nu$$

is determined by known matrix elements and a constant factor.

G.E.Brown

530.145

2790. NUCLEON–ANTINUCLEON FORCES IN THE INTERMEDIATE COUPLING THEORY. M.Lévy.
Nuovo Cimento, Vol. 8, No. 1, 92-134 (April 1, 1958).

A semi-phenomenological approach to meson theory is used in order to calculate the nucleon–antinucleon complex interaction responsible for the scattering and annihilation of antinucleons in hydrogen. It is assumed that the main part of the imaginary potential is due to processes involving virtual annihilation into an arbitrary number of mesons, all of them but one being emitted or absorbed in a p-state. An effective Hamiltonian is derived for such processes, from which a static interaction can be calculated, the nucleon and antinucleon being treated as fixed sources. The intermediate coupling theory of Tomonaga is extended to the two-body

problem and applied first to the calculation of ordinary nuclear forces and of the real part of the nucleon–antinucleon interaction. The annihilation Hamiltonian is then treated approximately by the intermediate coupling method. The imaginary part of the potential is found to have a range of the order of 2 to 3×10^{-13} cm, beyond which it becomes a weakly oscillating function of the nucleon–antinucleon distance. The physical meaning of this result is discussed, as well as the effects which would tend to sharpen the definition of the emitted pions multiplicity. In particular, a method is proposed to investigate, in the framework of the intermediate coupling theory, the influence of the excited states of the nucleon–antinucleon system. A.

530.145

2791. ON TIME-IRREVERSIBLE NUCLEON–NUCLEON SCATTERING. R.J.N.Phillips.
Nuovo Cimento, Vol. 8, No. 2, 265-70 (April 16, 1958).

The nucleon–nucleon S-matrix is parametrized by an extension of the phase-shift method, assuming parity conservation but not time-reversal invariance. One additional real parameter is needed for each two-channel (coupled triplet) process.

R.J.N.Phillips

530.145

2792. PERTURBATION EXPANSIONS IN THE FORMAL THEORY OF SCATTERING. J.E.Young.
Phys. Rev., Vol. 109, No. 6, 2141-4 (March 15, 1958).

Expressions are derived for the matrix elements of the transition operator relevant to that situation in which so-called surface potentials are to be taken into account as perturbations upon the usual core potentials. Some comparison is made of the class of approximations which appear in the literature and the restrictions upon their generality. A.

530.145

2793. BOUNDS ON SCATTERING PHASE SHIFTS. I. L.Spruch and M.Kelly.
Phys. Rev., Vol. 109, No. 6, 2144-8 (March 15, 1958).

This paper investigates the method of obtaining bounds on scattering phases developed by Kato (Abstr. 778/1952). Circumstances under which it is possible to obtain rather good bounds on the phase shifts by simple procedures are investigated. Useful formulae and techniques are presented and illustrative examples given. A.

530.145

2794. BOUNDS ON SCATTERING PHASE SHIFTS. II. L.Spruch.
Phys. Rev., Vol. 109, No. 6, 2149-59 (March 15, 1958).

Though the Kato technique for obtaining bounds on the cotangent of the scattering phase-shift, $\bar{\eta}_L$, is extremely general and powerful, an integration must be performed which can be quite troublesome, and some preliminary, albeit crude, information about $\bar{\eta}_L$ is required before the method can be applied. It is shown here that in the evaluation of the upper bound on $\cot\bar{\eta}_L$, the integration can often be eliminated without any significant increase in the value of the upper bound. It is also shown that the Kato formalism is often useful even when one does not possess the necessary a priori knowledge of $\bar{\eta}_L$; under realistic specified conditions, a bound can be obtained on $\bar{\eta}_L$ even when a bound cannot be obtained on $\cot\bar{\eta}_L$. Further, a procedure analogous to iteration is introduced whereby this bound on $\bar{\eta}_L$ can be improved. The bound on $\bar{\eta}_L$ is of interest in its own right. It may also help to provide the preliminary information necessary for the determination of bounds on $\cot\bar{\eta}_L$. It is shown that if the potential V(r) is nonpositive, $\bar{\eta}_{L+}$ and/or $|\bar{\eta}_{L-}|$ must be larger than the Born phase-shift η_{BL+}, where $\bar{\eta}_{L\pm}$ are the phase-shifts associated with $\mp V$; if $V(r) \leq 0$ and if $|\bar{\eta}_{L\pm}| < \pi$, then $\cot\bar{\eta}_{L+} - \cot\bar{\eta}_{L-} \leq 2\cot\eta_{BL+}$. A slight generalization of the Schwinger integral variational principle gives similar results for phases related to $V \pm U$. A.

530.145

2795. DIRECT FORMULATION OF CAUSALITY REQUIREMENTS ON THE S OPERATOR. I.E.Segal.
Phys. Rev., Vol. 109, No. 6, 2191-8 (March 15, 1958).

From a relatively operational causality assumption roughly to the effect that outgoing particles can be observed only when there have previously been incoming particles, dispersion relations for forward scattering of a scalar particle may be derived, in a manner that extends in principle to all types of scattering. A.

530.145

2796. IDENTICAL SCATTERING FROM CAUSAL AND NON-CAUSAL INTERACTIONS. S.Gasiorowicz and M.A.Ruderman.
Phys. Rev., Vol. 110, No. 1, 261-4 (April 1, 1958).

The scattering amplitude is explicitly written in terms of the commutator of the field operators far from the scatterer only, so that 'microscopic causality" cannot be inferred from the scattering amplitude alone. It is shown how to construct a nonlocal Hamiltonian for a Klein–Gordon particle which gives exactly the same scattering at all angles and momenta as that from an arbitrary local scalar potential, but differs in that the commutator of the field operators does not vanish everywhere outside the light cone. A.

530.145

2797. SYMMETRIES IN THE ELASTIC SPIN ½ – SPIN 0 SCATTERING. R.van Wageningen and H.J.Groenewold.
Physica, Vol. 23, No. 8, 720-6 (Aug., 1957).

For the elastic scattering of spin ½ particles by spin 0 scatterers four sets of closely related phase-shifts are considered, namely $\{\eta_l^{\pm(0)}\}$; $\{\eta_l^{\pm(1)} = -\eta_l^{\pm(0)}\}$; $\{\eta_l^{+(2)} = \eta_{l+1}^{-(0)},\ \eta_{l+1}^{-(2)} = \eta_l^{+(0)}\}$; $\{\eta_l^{+(3)} = -\eta_{l+1}^{-(0)},\ \eta_{l+1}^{-(3)} = -\eta_l^{+(0)}\}$. Experimentally these four sets can only be distinguished from each other by polarization measurements before and after the scattering. A short discussion on the interactions responsible for the phase shifts is added. A.

530.145

2798. THE DESCRIPTION OF COLLECTIVE MOTIONS IN TERMS OF MANY-BODY PERTURBATION THEORY. II. THE CORRELATION ENERGY OF A FREE-ELECTRON GAS. J.Hubbard.
Proc. Roy. Soc. A, Vol. 243, 336-52 (Jan. 14, 1958).

For Pt I see Abstr. 8430 (1957). The theory developed in Pt I is applied to calculate the correlation energy of a free-electron gas. The theory involves no cut-off and gives a uniform description of collective motion effects in the long-range limit and of particle motion effects in the short-range limit. It is shown that in the lowest order the theory agrees with Bohm and Pines's plasma oscillation theory in the long-range limit, but is inadequate in the short-range limit. The theory is approximately evaluated to the next order, which is correct in the short-range limit, and is applied to calculate the correlation energy at several gas densities; the results are in good agreement with those of Bohm and Pines. A.

530.145 : 539.2

2799. THE DESCRIPTION OF COLLECTIVE MOTIONS IN TERMS OF MANY-BODY PERTURBATION THEORY. III. THE EXTENSION OF THE THEORY TO THE NON-UNIFORM GAS. J.Hubbard.
Proc. Roy. Soc. A, Vol. 244, 199-211 (March 11, 1958).

The theory previously developed and applied to calculate the correlation energy of a free-electron gas (see preceding abstract) is extended in this paper to calculate the energy of an electron gas in a potential field. Two new features arise: (i) the introduction of a self-consistent field which is a generalization of the ordinary Hartree field; (ii) the occurrence of "local field correction" effects. It is shown that the energy of the gas can be expressed in terms of the eigenvalues of a certain homogeneous integral equation and a stationary principle for these eigenvalues is given. The theory is applied to crystals and an approximate expression for the correlation energy of a metal is derived neglecting Lorentz–Lorenz correction effects. A.

530.145

2800. NON-LINEAR MESON-FIELD EQUATIONS. A.Borgardt.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 59-66 (1957). In Russian.

All possible variants of pseudoscalar mesodynamics with third-order self-action are considered. Asymptotic expressions for non-relativistic potentials of point nucleons are obtained. Wave solutions of the non-linear equations which correspond to plane waves and also the problem of definiteness of energy density are also investigated. A.

530.145

2801. THE REPRESENTATION OF SYSTEMS OF PARTICLES IN PHYSICAL SPACE AND THE CAUSAL INTERPRETATION OF WAVE MECHANICS. J.Andrade e Silva.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 2018-21 (Dec. 4, 1957). In French.

The theory of the double solution is used to obtain a representation in physical space for the case of a two-particle system. Using an earlier analysis by de Broglie and the author (Abstr. 887/1958), it is shown that as a consequence of this representation, the movements of the singularities in configuration space are given by the Schrödinger equation. P.M.Davidson

530.145

2802. ON TIME-INVERSION; TRANSFORMED WAVE-FUNCTIONS AND WAVE EQUATIONS. R.Potier.
C.R. Acad. Sci. (Paris), Vol. 245, No. 26, 2485-7 (Dec. 23, 1957). In French.

The linear representations of the full Lorentz group are examined, by extending the orthochronous Lorentz group with the simultaneous inversion of the four axis. See also Abstr. 8428 (1957). J.Lascoux

530.145

2803. SOME PROPERTIES OF PREDICTIONS IN QUANTUM MECHANICS. A.Guichardet.
C.R. Acad. Sci. (Paris), Vol. 245, No. 26, 2488-90 (Dec. 23, 1957).

The question of simultaneous measurements of several physical quantities is discussed in terms of the spectral decomposition of the corresponding operators. J.Lascoux

530.145

2804. ON WAVE EQUATIONS FOR PARTICLES WITH HELICITY ("SCREW-PARTICLES"). R.Potier.
C.R. Acad. Sci. (Paris), Vol. 246, No. 2, 243-6 (Jan. 13, 1958). In French.

A general method is given for constructing wave equations which are not invariant under space reflection. J.C.Taylor

530.145

2805. ON IRREVERSIBLE PROCESSES IN QUANTUM MECHANICS. I.Prigogine and M.Toda.
Molecular Phys., Vol. 1, No. 1, 48-62 (Jan., 1958).

The methods developed by Prigogine and his colleagues are applied to the study of quantum mechanical systems. The density matrix is divided into a slowly varying and an oscillatory part, and asymptotic equations are established for the elements of this matrix. In the representation in which the unperturbed Hamiltonian is diagonal, these equations take a particularly simple form for weakly coupled systems: the matrix elements lying on diagonals parallel to the principal diagonal undergo separate transformations. A particular case is that of the diagonal elements themselves; for these the well-known Pauli equations are obtained. As an illustrative example the problem of the frictional forces on an oscillator immersed in a thermostat is considered in detail. The frictional forces introduced by Langevin and Lorentz are special cases of this. A.

530.145

2806. NOTE ON COULOMB WAVE FUNCTIONS. A.S.Meligy.
Nuclear Physics, Vol. 5, No. 4, 615-16 (March, 1958).

The expansions of certain radial wave-functions reported previously (Abstr. 7155/1956) are related to standard notations. R.J.N.Phillips

530.145

2807. DISCRETE STATES FOR SINGULAR POTENTIAL PROBLEMS. F.L.Scarf.
Phys. Rev., Vol. 109, No. 6, 2170-6 (March 15, 1958).

The solutions of the quantum mechanical wave-equations for singular potentials are re-examined. It is shown that a set of orthonormal wave-functions with complex energy eigenvalues ($E_n \mp W_n \pm \frac{1}{2}i\Gamma_n$) is obtained if certain natural analyticity requirements are imposed on the form of the potentials. In general, the result is interpreted in the following way: W_n is the most probable position of the energy level for various types of cutoff and Γ_n is a measure of the probable error. A.

530.145

2808. FORMULATION OF QUANTUM MECHANICS BASED ON THE QUASI-PROBABILITY DISTRIBUTION INDUCED ON PHASE SPACE. G.A.Baker, Jr.
Phys. Rev., Vol. 109, No. 6, 2198-206 (March 15, 1958).

It is shown that this formulation is equivalent to the standard formulation, and that the quasi-probability function is exactly analogous to the density matrix of Dirac and von Neumann. The theory of measurement in this formulation is investigated and the following remarkable results are derived. As is well known, the correspondence between classical functions of both the position and conjugate momentum and quantum mechanical operators is ambiguous because of noncommutativity. It is shown that the solution of this correspondence problem is completely equivalent to the solution of the eigenvalue problem. This result leads to give a constructive method to compute eigenvalues and eigenfunctions. A.

530.145

2809. CLASSICAL LIMITS OF CLEBSCH–GORDAN COEFFICIENTS, RACAH COEFFICIENTS AND $D^l_{mn}(\varphi,\theta,\psi)$-FUNCTIONS. P.J.Brussaard and H.A.Tolhoek.
Physica, Vol. 23, No. 10, 955-71 (Oct., 1957).

The "classical limits" (asymptotic expressions for large angular momenta) are investigated for a number of quantities. Some relations for Clebsch–Gordan coefficients and Racah coefficients for large angular momenta are derived. Classical analogues for the square of Clebsch–Gordan coefficients and the square of the $D^l_{mn}(0,\theta,0)$ functions are proposed on the basis of their geometrical meaning. W.K.B. expressions are derived for $D^l_{mn}(\varphi,\theta,\psi)$ starting from the Schrödinger equation for the symmetric top. These expressions include W.K.B. expressions for the spherical harmonics $Y_{lm}(\theta,\varphi)$. It is shown in which way these W.K.B. expressions are related to the classical analogues for the Clebsch–Gordan coefficients and $D^l_{mn}(\varphi,\theta,\psi)$ functions. A.

530.16

2810. CAUSALITY CONDITION AND THE CRITERIA OF PHYSICAL REALIZABILITY. L.A.Khalfin.
Vestnik Leningrad. Univ. Ser. Fiz. Khim. No. 3 (1957) No. 16, 5-18. In Russian.

The paper considers the general consequences arising from fulfilling the principle of causality in the quantum theory for a field, classical electrodynamics and theoretical radiotechnics. The well-known "dispersion" relations are derived and criteria of physical realizability discussed, based on the fundamental Paily–Wiener theorem. C.R.S.Manders

530.16 : 535.32

2811. CAUSALITY AND THE KRAMERS–KRONIG RELATION. I. N.G. van Kampen.
Ned. Tijdschr. Natuurkde., Vol. 24, No. 1, 1-14 (Jan., 1958). In Dutch.

The optical dispersion relation is discussed in analogy to elastic, magnetic and other physical phenomena. The propagation of light in a medium is formally considered, and application is made in the theory of electrons (Lorentz, metal theory). E.P.Wohlfarth

530.16 : 535.43 : 539.12

2812. CAUSALITY AND THE KRAMERS–KRONIG RELATION. II. N.G. van Kampen.
Ned. Tijdschr. Natuurkde., Vol. 24, No. 2, 29-42 (Feb., 1958). In Dutch.

The dispersion relations are applied in problems of scattering of light by individual scattering centres, and of particles by nuclei. The status of the relations in field theory and meson physics are also discussed. E.P.Wohlfarth

530.162 : 532.7 : 533.7

2813. STATISTICAL MECHANICS OF FLUIDS; FLUCTUATIONS AND LOCAL PROPERTIES. [Mécanique statistique des fluides; fluctuations et propriétés locales]. D.Massignon.
Paris: Dunod (1957) xiv + 263 pp. [Travaux et Recherches Mathématiques. I]. In French.

This book is an account of existing theories of equilibrium and non-equilibrium properties of simple fluids. The approach is unified, critical and original with a somewhat unorthodox notation (e.g. the use of "distributions" in connection with coarse-grained averaging) but most of the important results are fairly well known and later stages in the derivations are often shirked. There is no attempt made to bring the theory into contact with experiment. The topics discussed in the book include the kinetic expressions for momentum and energy flux, fluctuations and correlations in space and time, equilibrium properties in an external field and the quantum statistical theory of fluids. Perhaps the most valuable new feature is the way in which external fields are taken into account right through the work. The bibliography contains 150 items but it is by no means complete. R.O.Davies

530.162 : 530.145

2814. A CERTAIN METHOD FOR CALCULATION OF QUANTUM DISTRIBUTION FUNCTIONS. R.L.Stratonovich.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 6, 1097-100 (1957). In Russian.

Reviews quantum field theoretical methods for calculating the interaction Hamiltonian and Lagrangian functions for a statistical assembly; a simple extension of these procedures, combined with the density matrix formulation, enables the distribution function to be calculated. The application of the method to certain cooperative phenomena is discussed. J.W.Gardner

530.162

2815. CONSTANT PRESSURE ENSEMBLES IN STATISTICAL MECHANICS. W.B.Brown.
Molecular Phys., Vol. 1, No. 1, 68-82 (Jan., 1958).

A new statistical procedure is described for obtaining the thermodynamic properties of a molecular system directly as functions of the pressure. This procedure differs in principle from that suggested by Guggenheim in that the members of the representative ensemble are envisaged as being in constant mechanical equilibrium with the exterior. The quantal and classical theories of petit microcanonical and canonical ensembles of systems at constant pressure are presented, and shown to lead to the established results for perfect and imperfect gases, and for a hypothetical one-dimensional system. The conclusion that the statistical compressibility of a molecular system is essentially positive follows directly from the theory. An alternative procedure which leads to a more satisfactory form of Guggenheim's equation is also described, and its relation to the new approach is shown. A.

530.162

2816. RESTRICTED RANDOM WALKS AND THE USE OF MOMENTS. R.A.Sack.
Phil. Mag. (Eighth Ser.), Vol. 3, 504-7 (May, 1958).

It is shown that the method of moments can be applied to many problems of random walks on lattices with inequivalent sites. The method is illustrated by two simple examples. A.

530.162

2817. ANALYSIS OF CLASSICAL STATISTICAL MECHANICS BY MEANS OF COLLECTIVE COORDINATES.
J.K.Percus and G.J.Yevick.
Phys. Rev., Vol. 110, No. 1, 1-13 (April 1, 1958).

The three-dimensional classical many-body system is approximated by the use of collective coordinates, through the assumed knowledge of two-body correlation functions. The resulting approximate statistical state is used to obtain the two-body correlation function. Thus, a self-consistent formulation is available for determining the correlation function. Then, the self-consistent integral equation is solved in virial expansion, and the thermodynamic quantities of the system thereby ascertained. The first three virial coefficients are exactly reproduced, while the fourth is nearly correct, as evidenced by numerical results for the case of hard spheres. A.

530.162

2818. DERIVATION OF THE PHENOMENOLOGICAL EQUATIONS FROM THE MASTER EQUATION. I. EVEN VARIABLES ONLY.
N.G.van Kampen.
Physica, Vol. 23, No. 8, 707-19 (Aug., 1957).

The "master equation" describes the behaviour of a macroscopic system in terms of a time dependent probability distribution. It is here shown that, if the initial distribution is concentrated in a small region, it moves toward equilibrium without spreading. Thus the stochastic process described by the master equation is observed as a deterministic process by an observer whose observations are too coarse to observe the fluctuations. This is the process to which the usual phenomenological equations refer. With the aid of appropriate approximations one finds in this way the well-known linear regression equations, including Onsager's reciprocal relations. A.

530.162

2819. DERIVATION OF THE PHENOMENOLOGICAL EQUATIONS FROM THE MASTER EQUATION. II. EVEN AND ODD VARIABLES.
N.G.van Kampen.
Physica, Vol. 23, No. 9, 816-24 (Sept., 1957).

The analysis of Pt I is extended to the case in which both even and odd variables are needed to describe the macroscopic state of a system. In linear approximation this leads to the usual phenomenological equations, obeying reciprocal relations in the form given by Casimir. The fluctuations about this average behaviour are also fully described by the master equation; as an example the Nyquist formula is derived. A.

530.162 : 532.7 : 533.7

2820. NODAL EXPANSIONS. DISTRIBUTION FUNCTIONS, POTENTIALS OF AVERAGE FORCE, AND THE KIRKWOOD SUPERPOSITION APPROXIMATION. E.Meeron.
Phys. Fluids, Vol. 1, No. 2, 139-49 (March-April, 1958).

The customary density power series expansions of potentials of average force and distribution functions are converted into a new class of expansions, defined in terms of topological nodes. The physical meaning of the terms in the new expansion is discussed, and arguments are presented to show that the new expansions can be expected to converge considerably more rapidly than the customary density expansions. The probable occurrence of phase transitions is discussed. Possible further developments are suggested. The Kirkwood superposition approximation (Abstr. 2653/1935) is shown to be valid for a large number of terms in the expansions of potentials of average force and distribution functions. The customary comparison of the exact value of the third virial coefficient with that obtained via the Kirkwood superposition approximation is shown to provide no proof of the validity or invalidity of the latter. A.

530.162 : 535.43

2821. CORRELATION THEORY OF THERMAL FLUCTUATIONS IN AN ISOTROPIC MEDIUM. S.M.Rytov.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 166-78 (1957). In Russian.

The so-called "fluctuation-dissipation" theorem of Callen et al. (1951-2) is used to develop a spectral theory of thermal fluctuations in an isotropic elasto-viscous continuous medium. The mechanical and thermal parameters of the medium in this case can possess any frequency dispersion consistent with the dissipation condition. Correlation functions of ωk amplitudes (amplitudes of Fourier time–space expansions) were determined for stress, deformation, velocity, temperature and entropy fluctuations. Using these equations the spectral intensities (which yield spatial correlation at a frequency ω), as well as the spatial correlation functions of quantities which are not decomposed spectrally, can be calculated. The results are useful in the spectral theory of Rayleigh scattering of light. A.

530.162 : 532.5 : 538.3

IRREVERSIBLE STATISTICAL MECHANICS OF INCOMPRESSIBLE HYDROMAGNETIC TURBULENCE. See Abstr. 2426

530.19

2822. ON THE VARIATIONAL PROBLEM CONNECTED WITH THE THOMAS FERMI METHOD. Y.Tanabe.
J. Phys. Soc. Japan, Vol. 12, No. 8, 974 (Aug., 1957).

The problem of minimizing the total energy expression for a molecule is transformed to that of maximizing a certain functional. Upper and lower bounds are thus obtained for the Thomas–Fermi energy, as well as an upper bound for the mean square error of the approximate ∇V_e. D.M.Edwards

GENERAL MECHANICS. MECHANICS OF SOLIDS

531.25 : 535.55

2823. THE INFLUENCE ON THE STRESS DISTRIBUTION IN AN ADHESIVE LAP JOINT OF BENDING OF THE ADHERING SHEETS. A.S.McLaren and I.MacInnes.
Brit. J. appl. Phys., Vol. 9, No. 2, 72-7 (Feb., 1958).

The mathematical analysis of Goland and Reissner (Abstr. 1535/1944) of the effect of deformation due to load is tested photoelastically and extended to cover a wider range of suchlike deformations. It is shown that the introduction of a bending moment in the sheets opposite to that occurring in the conventional joint can produce a stress distribution on the glue line free from high normal stresses and fairly uniform in shear. A modified design of lap joint to ensure this is proposed. A.

531.259.1 : 535.55

2824. PHOTOELASTIC INVESTIGATION OF STRESSES IN COMPOSITE MODELS WITH NOTCHES AND HOLES.
H.Shimada.
Brit. J. appl. Phys., Vol. 9, No. 1, 34-7 (Jan., 1958).

The object of the work was to obtain information about the stresses in stiffened plastic bars. Tests were carried out under tension on a composite bar with a circular hole, and under bending, on a composite bar with a semicircular notch. The bars were of epoxy resin stiffened with duralumin strips. Graphs were obtained from which the stress-concentration factors of the stiffened models may be deduced from those in similar unstiffened models. A.

531.578

2825. DYNAMICS OF A PROJECTILE PENETRATING SAND. II.
W.A.Allen, E.B.Mayfield and H.L.Morrison.
J. appl. Phys., Vol. 28, No. 11, 1331-5 (Nov., 1957).

For Pt I see Abstr. 5096 (1957). Additional data are reported

that confirm a theory presented in a previous paper for the penetration of a stable flat-nosed projectile in sand. The negative acceleration of the projectile can be expressed by the relations: $-dv/dt = \alpha v^2$, $v_0 > v > v_c$; $-dv/dt = \beta v^2 + \gamma$, $v_c > v > 0$; where the coefficients α, β, γ are positive constants and v_0 is the striking velocity. In the case where air is removed from the sand and the sand is loaded transverse to the trajectory by 1 atm pressure, the coefficients α and β are characteristic of inelastic and elastic impact, respectively, where the flow process is regarded as Newtonian. An additional experiment was performed where the quartz powder produced by impact is plotted as a function of initial projectile energy. Although the powder-production curve can be represented roughly as a straight line through the origin, there are small discontinuities in slope corresponding to the critical velocity $v = v_c$. The velocity of sound in sand was measured under the conditions of the experiments. Loading increases the velocity of sound markedly, but has little effect on the critical velocity v_c. A.

MECHANICAL MEASUREMENTS

531.715

2826. DIVIDING MECHANISMS BASED ON THE CRYSTALLOGRAPHIC PRINCIPLE OF THE CLOSE PACKING OF GEOMETRICALLY IDENTICAL BODIES. V.A.Shamburov.
Kristallografiya, Vol. 2, No. 1, 172-8 (1957). In Russian.

Working drawings and photographs are given of mechanisms for linear and circular division, based on the close packing of small spheres. R.F.S.Hearmon

531.717.1 : 535.51

2827. COMMENT ON THE ROTHEN PHOTOELECTRIC ELLIPSOMETER. R.D.Mattuck; A.Rothen.
Rev. sci. Instrum., Vol. 28, No. 10, 844, 845 (Oct., 1957).

Mattuck states that to determine film thickness d by the Rothen method (Abstr. 5903/1957) a value for the refractive index n is essential. Refractive indexes cannot be determined for values of d less than 300 A, so that for such thicknesses the Rothen method cannot be used. Reference is made to a method (Abstr. 7317, 7318/1956; 1213/1957) that gives d and n simultaneously for the range from 10 to 250 A. Rothen states that his method refers to optical thicknesses, and for these the instrument is sensitive to changes of 0.1 A in the range from 0 to 300 A. H.G.Jerrard

531.756

2828. DETERMINATION OF DENSITY OF LIQUIDS UNDER ELEVATED GAS PRESSURE. K.Goldman.
Brit. J. appl. Phys., Vol. 9, No. 1, 40-2 (Jan., 1958).

A new method of density measurement using an open-end hydrometer was developed for liquids under elevated gas pressure. It was successfully employed for determining densities of high vacuum oil (Apiezon A), saturated with nitrogen, at 25°C in the pressure range from 1 to 300 atm. The estimated accuracy of determination was better than 1 in 1000. A.

531.761 : 532.65

A TWO-CAMERA TECHNIQUE FOR MEASURING FALL VELOCITIES. See Abstr. 2844

531.78

2829. MEASUREMENTS OF PRESSURE DISTRIBUTION BETWEEN METAL AND RUBBER COVERED ROLLERS. G.J.Parish.
Brit. J. appl. Phys., Vol. 9, No. 4, 158-61 (April, 1958).

Measurements are described of pressure distribution in the nip between a metal roller and a roller consisting of a thin rubber cover on a metal shell under various conditions of load, cover hardness and cover thickness. The results, although in qualitative agreement with Hannah's theory (Quarterly Journal of Mechanics and Applied Mathematics, Vol. 4, 94, 1951), show appreciable deviations from the quantitative theoretical predictions, and the possible causes of this discrepancy are discussed. A.

531.782 : 539.382

2830. A SIMPLE TENSILE TESTING MACHINE FOR VERY FINE WIRES. A.E.Widdowson.
J. sci. Instrum., Vol. 35, No. 3, 100-1 (March, 1958).

Stress/strain curves can be obtained for fine tungsten wires as small as 5 μ in diameter. A.

531.787.1

2831. THE RECORDING OF PRESSURE DISTRIBUTIONS IN POROUS MEDIA DURING FLUID FLOW EXPERIMENTS. T.O'Donnell, D.H.Edwards, N.Collis-George and E.G.Youngs.
J. sci. Instrum., Vol. 35, No. 2, 63-4 (Feb., 1958).

A null-point method is described of recording in a short time interval pressure distributions in a porous medium during fluid flow experiments. Small cells, buried at numerous points in the porous material, measure the pressure distribution, which is recorded in a separate laboratory. A.

531.787.2

2832. A VIBRATING CONDENSER MANOMETER. J.L.Williams and G.F.Eveson.
J. sci. Instrum., Vol. 35, No. 3, 97-9 (March, 1958).

The principle of the use of a vibrating capacitor to measure small displacements was applied to an instrument to record cyclic fluctuations of air pressure. A summary is made of the results of simple experiments carried out to investigate factors influencing the amplitude of the signal generated by a vibrating capacitor. A description is given of a simple, robust instrument which was used to measure fluctuating air pressures, and reference is made to its characteristics. A.

MECHANICS OF FLUIDS

532.133

2833. THE VISCOSITY OF LEAD, TIN, AND THEIR ALLOYS. W.R.D.Jones and J.B.Davies.
J. Inst. Metals, Vol. 86, Pt 4, 164-76 (Dec., 1957).

The apparatus based upon the outer-rotating-cylinder method, previously used to determine the viscosity of Al alloys (J. Inst. Metals, 1952-53, 81, 145) and of Cu alloys (ibid., 1954-55, 83, 59) was modified to suit the higher density of Pb–Sn binary alloys. The results are compared with those published previously. The relationship between viscosity and temperature is as anticipated, except near the freezing point, where the viscosity increases rapidly. The viscosity varies in accordance with the equilibrium diagram, a marked change being found at the limit of solid solubility and a minimum at the eutectic. Small additions of tin increase appreciably the viscosity of lead. A.

532.14 : 539.18

2834. MEASUREMENT OF LOW DEUTERIUM CONCENTRATION IN WATER BY MEANS OF FLOAT METHOD. B.Brigoli, E.Cerrai and M.Silvestri.
J. sci. Instrum., Vol. 34, No. 7, 292-3 (July, 1957).

The method consists of determining the temperature at which the density of a purified sample equals the effective density of a float. Experimental values of deuterium concentration obtained show good agreement with calculated values. The accuracy is 2-3 p.p.m. deuterium in hydrogen. H.C.Cole

532.2 : 536.25

2835. SOME FURTHER RESULTS ON THE BÉNARD PROBLEM. W.H.Reid and D.L.Harris.
Phys. Fluids, Vol. 1, No. 2, 102-10 (March-April, 1958).

The exact solution of the sixth-order differential equation which governs the stability of a viscous fluid contained between two rigid walls and heated from below is briefly reviewed and extended to include detailed results on the curve of neutral stability and the cell pattern at the onset of instability. Two approximate methods of solution are then discussed which employ a Fourier or Fourier-type expansion and which require the solution of only a fourth- or a second-order differential equation. A comparison of these approximate results with the exact solution gives some insight into the relative accuracy of these methods when applied to other more general problems for which an exact solution cannot be obtained. A.

532.516

2836. STUDIES IN NEWTONIAN FLOW. V. FURTHER VERIFICATION OF THE FREE-SPACE VISCOSITY EQUATION. A.K.Doolittle and D.B.Doolittle.
J. appl. Phys., Vol. 28, No. 8, 901-5 (Aug., 1957).

For Pt IV see Abstr. 4159/1952. Values of the limiting specific volume v_0 calculated by a trial-and-error procedure from n-alkane viscosity data using the author's free-space viscosity equation, $\ln\eta = B(v_0/v_f) + \ln A$, agree substantially with previously published

values obtained by extrapolation of density data. Values of v_0 for Hg, Na, benzene, carbon tetrachloride, dichlorodifluoromethane, and water were calculated by the same trial-and-error procedure. In all cases the free-space equation gave a much better fit than the corresponding Andrade temperature equation, $\ln\eta = B/T + \ln A$.

A.

532.517.4

2837. ON THE DECAY OF HOMOGENEOUS TURBULENCE BEFORE THE FINAL PERIOD. R.G.Deissler.
Phys. Fluids, Vol. 1, No. 2, 111-21 (March-April, 1958).

A three-point correlation equation is used to obtain a relation for the triple correlations applicable at times before the final period. In this case the equation is made determinate by neglecting the quadruple correlations. Higher order approximations, valid at still earlier times, could be obtained by considering four- or five-point correlation equations. In each case the set of equations is made determinate by neglecting the highest order correlation. Only two- and three-point correlation equations are considered here. The correlation equations are converted to spectral form by taking their Fourier transforms. Expressions are obtained for the energy transfer function, which describes the transfer of energy from large to small eddies, and for the energy spectrum function which gives the contributions of the various eddy sizes to the total energy. By integrating the energy spectrum over all wave-numbers (or eddy sizes), the following energy decay law is obtained:

$$\overline{u^2} = A(t - t_0)^{-5/2} + B(t - t_0)^{-7},$$

where $\overline{u^2}$ is the mean square of the velocity fluctuation, t is the time, and A, B, and t_0 are constants determined by the initial conditions. For large times the last term becomes negligible leaving the well-known $-5/2$ power decay law for the final period. Comparison of the decay law with experimental data indicates good agreement for times considerably before, as well as during, the final period. A.

532.52

2838. FLOW OF A VISCOUS LIQUID ON A ROTATING DISK.
A.G.Emslie, F.T.Bonner and L.G.Peck.
J. appl. Phys., Vol. 29, No. 5, 858-62 (May, 1958).

Equations describing the flow of a Newtonian liquid on a rotating disk are solved so that characteristic curves and surface contours at successive times for any assumed initial fluid distribution may be constructed. It is shown that centrifugation of a fluid layer that is initially uniform does not disturb the uniformity as the height of the layer is reduced. It is also shown that initially irregular fluid distributions tend toward uniformity under centrifugation, and means of computing times required to produce uniform layers of given thickness at given angular velocity and fluid viscosity are demonstrated. Contour surfaces for a number of exemplary initial distributions (Gaussian, slowly falling, Gaussian plus uniform, sinusoidal) have been constructed. Edge effects on rotating planes with rising rims, and fluid flow on rotating nonplanar surfaces, are considered. A.

532.522

2839. NONLINEAR PROPERTIES OF CIRCULAR ORIFICES.
G.B.Thurston, L.E.Hargrove, Jr and B.D.Cook.
J. Acoust. Soc. Amer., Vol. 29, No. 9, 992-1001 (Sept., 1957).

The results of an experimental study of the nonlinear fluid flow properties of thin, square-edged, circular orifices are described. Liquids were used at low frequencies. The flow conditions considered are a sinusoidal oscillation of the fluid in the orifice, and a sinusoidal oscillation with a steady flow component added. For the sinusoidal flow condition the pressure differential developed across the orifice contains higher odd harmonics. The addition of a steady flow component adds second harmonic to the pressure as well as influences the magnitude of the odd harmonics. Further, in this case, the steady pressure component is a function of the magnitude of both the sinusoidal and steady flow components. An equation descriptive of the pressure—flow relation is presented. In this the orifice properties are specified by three constants, two of which are the acoustic resistance and acoustic inertance as normally measured at low amplitudes of excitation. The relations derived from this equation are compared with experimental measurements. A.

532.528

2840. MEASUREMENTS ON THE AIR-NUCLEI IN NATURAL WATER WHICH GIVE RISE TO CAVITATION.
K.S.Iyengar and E.G.Richardson.
Brit. J. appl. Phys., Vol. 9, No. 4, 154-8 (April, 1958).

For measuring the critical pressures for cavitation ultrasonic excitation is used. To estimate the size and number of the nuclei, methods based on reverberation and optical scattering are used. The changes in cavitation potential of aerated water with time, and the effect on the nuclei of subjecting the water to prolonged excess pressure are described. A.

532.59.08

2841. A WATER-WAVE MEASURING APPARATUS. A.Brebner.
J. sci. Instrum., Vol. 34, No. 12, 506-7 (Dec., 1957).

Component values are given for an electronic circuit designed to detect, amplify and rectify a variation in resistance produced by fairly rapidly changing water levels on a pair of immersed probes, a situation met in the measurement of water waves in laboratory experiments. The accuracy of such an apparatus is checked and assessed by comparing with the usual pointer-type of gauge, instead of by further electrical means. It is well within the usual requirements for such experimental work. A.

532.612.4

2842. EXPERIMENTAL RESEARCHES ON THE SURFACE TENSION OF LIQUIDS IN MOVEMENT.
M.Borneas and E.Kalman.
C.R. Acad. Sci. (Paris), Vol. 245, No. 20, 1710-13 (Nov. 13, 1957). In French.

Using an apparatus of the du Nouy type, the surface tension (γ) of a number of organic liquids and of water was measured when (a) the ring and (b) the cell was being rotated. The value of γ varies with the frequency of rotation, but this is not because of relative motion between the liquid and the ring. S.J.Gregg

532.612.4

2843. EXPERIMENTAL STUDY OF "CURTAINS" OF LIQUID IN RELATION TO SURFACE TENSION. C.Sălceanu.
C.R. Acad. Sci. (Paris), Vol. 245, No. 20, 1713-15 (Nov. 13, 1957). In French.

The ring method is used, but the maximum height of the "curtain" of liquid is measured instead of the force required to detach the ring from the surface. The formula of Mathieu (1883) is confirmed. S.J.Gregg

532.65 : 531.761

2844. A TWO-CAMERA TECHNIQUE FOR MEASURING FALL VELOCITIES. R.H.Magarvey.
J. sci. Instrum., Vol. 34, No. 12, 508-9 (Dec., 1957).

A photographic technique is described that affords data on several phenomena associated with freely falling drops. An essential feature of the technique is a two-camera shutter designed to obtain photographs of the falling drop at two fall distances. Velocities are calculated from a consideration of displacement and time data that appear on the photographs. Information regarding the dynamics of drop deformation is inferred from the geometry of the image pairs and the time interval between photographs. The time interval is dependent on the dimensions and speed of the shutter. The possible error in the calculated velocities of large drops is 2.5%. A.

MOLECULAR THEORY OF LIQUIDS

532.7

2845. THE INFLUENCE OF THE STRUCTURE OF LIQUIDS ON NUCLEAR RELAXATION BY TRANSLATION. J.Seiden.
C.R. Acad. Sci. (Paris), Vol. 245, No. 19, 1614-17 (Nov. 4, 1957). In French.

Expressions are developed for the nuclear relaxation time T_1' in a non-polar liquid taking into account intermolecular interactions. A complicated formula is obtained for the ratio T_1'/T_1 ($T_1 = T_1'$ in the absence of interactions) in terms of the radial distribution function of Mayer and Montroll (Abstr. 2254/1941). Values of important parameters are given for liquid Xe^{129}, N_2^{15}, $C^{13}O$, F_2. It is suggested that the theory will be qualitatively valid for some polar liquids. D.J.Oliver

532.7 : 532.133

2846. BULK VISCOSITY OF LIQUIDS. N.Hirai and H.Eyring.
J. appl. Phys., Vol. 29, No. 5, 810-16 (May, 1958).

The mechanisms for bulk viscosity are different between associated and nonassociated liquids. Here, a new mechanism for bulk viscosity is proposed from the standpoint of the hole theory of liquids and the rate process theory. This mechanism can explain the tem-

perature and pressure dependences of acoustic absorption for associated liquids and very viscous nonassociated liquids. A.

532.7 : 532.13

2847. BULK VISCOSITY AND SHEAR VISCOSITY IN FLUIDS ACCORDING TO THE THEORY OF IRREVERSIBLE PROCESSES. K.F.Herzfeld.
J. chem. Phys., Vol. 28, No. 4, 595-600 (April, 1958).

Green has connected the shear and bulk viscosities with the fluctuations of the virial. It is shown here that the virial theorem is correct at every moment, including the fluctuations, if the integral of the pressure over the volume is taken. For monoatomic fluids the bulk viscosity is calculated after introducing an unknown correlation length; for fluids with internal degrees of freedom or with two-state structure, the usual equations follow very easily. For the shear viscosity one finds a formula similar to that of Eyring by making some assumptions about correlations. A.

532.7

2848. TRANSPORT OF ENERGY AND MOMENTUM IN A DENSE FLUID OF ROUGH SPHERES. J.P.Valleau.
Molecular Phys., Vol. 1, No. 1, 63-7 (Jan., 1958).

Theoretical values are obtained for the thermal conductivity and the viscosity of a dense fluid of perfectly rough elastic spheres, on the basis of simple assumptions about the pair distribution functions. In this fluid angular momentum may be transferred from the bulk motion of the fluid to the rotations of the individual spheres. The rate of this transfer is given by an anti-symmetric component in the pressure tensor, and involves a coefficient of "rotational viscosity", analogous to the shear viscosity arising from the symmetric component. The thermal conductivity is found to be twice as great as that for perfectly smooth spheres, while the viscosities involve the moment of inertia of the spheres as well as their mass and radius. A.

532.7 : 536.71

2849. ONE-DIMENSIONAL MULTICOMPONENT MIXTURES. H.C.Longuet-Higgins.
Molecular Phys., Vol. 1, No. 1, 83-90 (Jan., 1958).

It is shown that a one-dimensional multicomponent mixture with nearest neighbour interactions $u_{ij}(r)$ obeys the implicit equation of state

$$\Delta(\lambda_A, \lambda_B, \ldots; T,P) \equiv |\lambda_i \eta_{ij} - \delta_{ij}| = 0$$

where λ_i is the absolute activity of species i (divided by a kinetic factor) and

$$\eta_{ij}(T, P) = \int_0^\infty \exp[-\{\mu_{ij}(r) + Pr\}/kT]dr.$$

The concentration of species i is thence determined as

$$-\lambda_i \frac{\partial \Delta}{\partial \lambda_i} \Big/ kT \frac{\partial \Delta}{\partial P}.$$

A one-dimensional solution is ideal if, and only if, the matrix $[\eta_{ij}]$ is of rank unity. The excess free energy of a nearly ideal solution is found to be

$$(\Delta^* G)_{T,P} = \sum_{i<j} \sum x_i x_j (G_{ij} + G_{ji} - G_{ii} - G_{jj})$$

where $G_{ij}(T,P)$ is the (configurational) molar Gibbs free energy of a "hybrid" species with interaction potential $u_{ij}(r)$. A.

532.7 : 533.7

2850. A METHOD FOR STUDY OF CORRELATIONS IN QUANTUM FLUIDS IN EQUILIBRIUM. J.Yvon.
Nuclear Phys., Vol. 4, No. 1, 1-20 (Aug., 1957). In French.

The first section recalls the essence of a method for studying correlations in a classical fluid in equilibrium. The following sections attempt to enlarge the method and to apply it to quantum fluids. The state of the system is no longer represented by wave-functions but by density operators. The properties of the perfect gases are first of all coordinated with the aid of these operators. Next the problem of systems with interactions is attacked. A series of recurrent equations defines a method of successive approximations. If one is prepared to admit that, in spite of the interactions, the correlations are those of perfect gases, the formulae are identical with those of the self-consistent field. For the case of short-range forces another method is proposed. It is developed from the classical method of Ursell for obtaining the equation of state of a fluid. The results seem to point to the possibility of a kind of Bose–Einstein condensation in a system of interacting fermions. The appearance of this phenomenon is due, on the one hand, to the importance, in all dense fluids, of correlations between the particles taken in pairs, and on the other hand to the fact that a pair of fermions constitute a boson. A.

532.7 : 533.7 : 530.162

STATISTICAL MECHANICS OF FLUIDS. See Abstr. 2813

532.7

2851. APPLICATION OF THE KIKUCHI–HIJMANS–DE BOER METHOD FOR ORDER–DISORDER PHENOMENA TO THE CELL MODEL OF THE LIQUID STATE. E.G.D.Cohen.
Physica, Vol. 23, No. 9, 801-15 (Sept., 1957).

A theory of the liquid state is given, which, as the cell model, uses a division of the liquid volume into a number of cells to specify the configurations of the molecules in the liquid. The different positions of a molecule in a cell are considered, however, as the different components of an order–disorder system. The calculation of the free energy of the liquid leads then to an order–disorder problem for an infinite number of components, which can be treated by generalizing the Kikuchi–Hijmans–De Boer method for order–disorder phenomena. The solution of the order–disorder problem in the Bragg–Williams approximation leads to the Lennard-Jones–Devonshire theory of the liquid state. Higher approximations to the order–disorder problem, which take into account the correlations between the motions of molecules in neighbouring cells, yield correction terms on this single cell theory. The theory presented can be generalized in several ways. A.

532.72

2852. THE TEMPERATURE VARIATION OF THE DIFFUSION COEFFICIENT OF SUNDRY SUBSTANCES IN WATER. V.A.Marinin.
Vestnik Leningrad. Univ. Ser. Fiz. Khim. No. 3 (1957) No. 16, 44-8. In Russian.

Measurements were made over a temperature range from 12 to 60° C for substances of differing molecular weight: methanol, glycerol, sugar, tannin, dextrin, polyvinyl alcohol. The temperature coefficient was found to be independent of the size of the diffusing molecules and approaches the viscosity temperature coefficient of the solvent (which shows a simple exponential variation).

C.R.S.Manders

532.72 : 535.417

MACH–ZEHNDER INTERFEROMETER FOR DIFFUSION MEASUREMENTS IN VOLATILE LIQUID SYSTEMS. See Abstr. 2256

532.73

2853. SERIES EXPANSION OF DISTRIBUTION FUNCTIONS IN MULTICOMPONENT FLUID SYSTEMS. E.Meeron.
J. chem. Phys., Vol. 27, No. 6, 1238-46 (Dec., 1957).

The equations of Kirkwood and Salzburg (Abstr. 10857/1954) for distribution functions are generalized to multicomponent systems. The generalized equations serve to derive a recurrence relation between the coefficients of powers of particle number densities in a Maclaurin expansion of the distribution functions. This recurrence relation is then used to derive the general term in the expansion of the distribution functions in terms of modified irreducible integrals in multicomponent systems, which includes the original one-component expansion of Mayer and Montroll as a special case. The corresponding expansion of the potentials of average force is derived. The use of the new expansion is illustrated by a relatively simple derivation of the Fuchs expansion of the grand potential in multicomponent systems. Possible applications to ionic solutions, impurities in solids and X-ray diffraction in solutions of several solutes are briefly discussed. Some new formulae in the theory of cumulants (Thiele semi-invariants) are presented. A.

532.74

2854. INTERMOLECULAR FORCES AND THE ACTIVATION ENERGY FOR VISCOUS FLOW IN LIQUIDS. T.H.S.Higgins and C.J.G.Raw.
J. chem. Phys., Vol. 27, No. 3, 623-4 (Sept., 1957).

The existing theoretical interpretation of the activation energy for viscous flow in terms of the intermolecular potential is discussed in the light of the Born–Green theory. This theory suggests the possibility of an absolute calculation of the activation energy. A simplified treatment affords results of the right order of magnitude. A.

532.74 : 548.74

2855. ELECTRON DIFFRACTION INVESTIGATIONS OF THE STRUCTURE OF THIN LIQUID FILMS OF TIN. A.I.Bublik.
Kristallografiya, Vol. 2, No. 2, 249-54 (1957). In Russian.

The radial distribution curves of atoms in liquid tin are constructed from electron diffraction data and the question of separating the incoherent background from the general intensity curve is discussed. Comparison of electron and X-ray diffraction results shows that the order in the distribution of particles in liquid tin is similar to that in the crystalline form, and that with increasing temperature the distribution of atoms in liquid tin tends to close packing.

R.F.S.Hearmon

532.74 : 548.74

2856. DETERMINATION OF THE RADIAL DISTRIBUTION FUNCTION OF ATOMS IN LIQUID METAL ALLOYS FROM ELECTRON DIFFRACTION DATA. A.I.Bublik and A.G.Buntar'.
Kristallografiya, Vol. 2, No. 2, 255-9 (1957). In Russian.

A theoretical investigation is made of the scattering of electrons, enabling the radial distribution function of atoms in liquid metal alloys to be constructed from electron diffraction data (see preceding abstract). R.F.S.Hearmon

532.77

2857. ELECTRON SPIN RELAXATION TIMES IN SODIUM–AMMONIA SOLUTIONS. R.J.Blume.
Phys. Rev., Vol. 109, No. 6, 1867-73 (March 15, 1958).

The transverse and longitudinal relaxation times (T_2 and T_1) were measured at 17.4 Mc/s (6.2 gauss) by r.f. pulse techniques. T_2 was obtained by measuring the decay time of the free-induction signal following a 90° flip, and was found to vary from about 3.2 μsec to 0.7 μsec as the sample concentration varied from 1.1 to 25.9 mg Na per g NH_3. T_1 was measured by the 180°-90° method over a concentration range of 4.9 to 16.9 mg Na/g NH_3. It was found that T_1 equals T_2 in this range to within about ± 10%, in accord with the theory of Bloembergen, Purcell, and Pound. Spin echoes from electrons were observed. Descriptions of the apparatus and the method of preparing the samples are included. A.

532.78

2858. APPROACH TO THE THEORY OF THE SECOND VIRIAL COEFFICIENT IN HIGH-POLYMER SOLUTIONS. E.F.Casassa.
J. chem. Phys., Vol. 27, No. 4, 970-1 (Oct., 1957).

A new approximate method for computing the second virial coefficient (A_2) of high polymer solutions is suggested. Preliminary numerical calculations show that A_2 decreases more rapidly with increasing molecular weight than is predicted by the theories of Flory–Krigbaum and Isihara–Koyama. This is in qualitative agreement with experiments. R.O.Davies

MECHANICS OF GASES

533.15 : 536.423

2859. OPERATION OF A CENTER-FED CONTINUOUS-FLOW THERMOGRAVITATIONAL COLUMN WITH UNEQUAL FLOW RATES IN THE TWO COLUMN SECTIONS. COMPARISON OF THEORY AND EXPERIMENT. J.E.Powers and C.R.Wilke.
J. chem. Phys., Vol. 27, No. 5, 1000-1 (Nov., 1957).

Equations of Jones and Furry (Abstr. 1273/1947) are shown to agree well with experimental data over a range of ratios of rectifying section flow to stripping section flow from 0.3 to 5. On the assumption of an effective feed location which yields maximum separation a tentative modification of the Jones–Furry equation is developed which appears preferable at smaller values of the flow rate. A.

533.15

2860. DIFFUSION COEFFICIENTS OF THE SYSTEMS Xe–Xe AND A–Xe. I.Amdur and T.F.Schatzki.
J. chem. Phys., Vol. 27, No. 5, 1049-54 (Nov., 1957).

The diffusion of radioactive A^{37} and of radioactive Xe^{131m} through inert xenon was measured at –78, 0, 57, and 105°C. The apparatus, a Loschmidt cell in which saturation ionization currents were used as a measure of tracer concentrations, yielded diffusion coefficients which are estimated to have an accuracy of about 1%. The intermolecular potentials of Xe–Xe, derived from the results, agree with those obtained from thermal conductivity data in the same temperature range, but do not agree with potentials derived from second virial coefficients and crystal data. Nor do they agree with potentials derived from viscosity and thermal conductivity data at higher temperatures. It is shown that this lack of agreement is due to the inadequacy of the potential form. The potential well for the rare gases should be narrower than that given by the Lennard-Jones 12-6 potential. A.

533.16 : 533.7

2861. FRICTION AND THERMAL EXCHANGES IN RAREFIED GASES. [Frottement et échanges thermiques dans les gaz raréfiés.] F.M.Devienne.
Paris: Gauthier-Villars (1958) viii + 132 pp. In French.

The first half of this monograph is a useful précis of the main facts about the flow of gases through tubes: Poiseuille flow, slip and its associated momentum transfer coefficient, molecular flow (Knudsen) and the intermediate region. Some newer experiments (including those by the author) are discussed but on the whole this part deals with well known material. The second half is more topical and expounds work done over the last decade on (a) the mechanical resistance of obstacles to a fast stream of gas and (b) the heat transferred to them by the stream. The discussion is mainly concerned with the "Knudsen" case (mean free path ≫ appropriate linear dimension of obstacle) but there is a chapter summarizing experimental results under "slip" conditions. The approach is physical rather than mathematical and retains good contact with experiment — particularly those by Stalder and by the author. The author emphasizes the dependence of accommodation coefficient on stream velocity and uses this critically in an interesting final chapter, in which he estimates the temperatures reached by objects moving in the upper atmosphere at heights up to 150 km and speeds up to 8000 m/s. The documentation of the text is unsatisfactory but there is a useful bibliography of 100 papers which gives their full titles. R.O.Davies

533.2 : 539.893

2862. A NEW METHOD OF PRODUCING SUPER-HIGH GAS PRESSURES. S.S.Boksha.
Kristallografiya, Vol. 2, No. 1, 198-200 (1957). In Russian.

A number of cylinders are provided with internal heating and connected in series by means of non-return valves. Gas is introduced into the system and the pressure in the final cylinder built up by the cyclic heating of the cylinders and the introduction of fresh gas. In an example quoted, the pressure of nitrogen gas was built up from 150 atm to 2000 atm. R.F.S.Hearmon

533.21 : 534.222.2

SHOCK HUGONIOT OF AIR. See Abstr. 2193

533.5 : 531.788

2863. PRESSURE MEASUREMENT IN VACUUM SYSTEMS. J.H.Leck.
London: Published on behalf of the Institute of Physics by Chapman and Hall (1957) 144 pp. [Physics in Industry Series].

Gives a comprehensive treatment of the subject in following chapters: (1) Mechanical manometers; (2) Thermal conductivity gauges; (3) Ionization gauges; (4) The Knudsen radiometer gauge; (5) Surface reaction techniques; (6) Gauge calibration. Numerous practical examples of design are included and a list of nearly two hundred references is given. J.M.Zarzycki

533.5 : 531.788.6

2864. A FEEDBACK CONTROLLED PIRANI GAUGE. J.H.Leck.
J. sci. Instrum., Vol. 35, No. 3, 107-8 (March, 1958).

A simple feedback circuit for the Pirani gauge is described, in which the power supply to the Wheatstone bridge is adjusted automatically so as to keep the wire temperature approximately constant over a wide range of pressure changes. This is achieved by supplying the power from a d.c. amplifier, which is itself controlled by changes in wire temperature, a small fall in temperature serving to increase the power output from the amplifier. A transistor is employed as the input stage of the amplifier. The comparatively large zero drifts in the transistor d.c. amplifier due to temperature changes are no particular disadvantage in this application as the Pirani gauge signal is also dependent upon ambient temperature. A.

533.5 : 531.788.7

2865. RELATIONS IN THE GAS DISCHARGE IN THE PENNING-TYPE OF VACUUM GAUGE. H.Moesta.
Z. angew. Phys., Vol. 8, No. 12, 598-603 (Dec., 1956). In German.

A special Penning-type gauge was built, in which the production of secondary ions and the recombination of primary ions are reduced to a minimum. The type of discharge under these conditions is then calculated and compared with that observed experimentally.

The material used for the cathode has a profound effect on the gauge characteristic. Good agreement is obtained between calculated and experimentally measured performance. T.Mulvey

533.59 : 537.534.3

2866. ANALYSIS OF RESIDUAL GASES REMAINING AT VERY LOW PRESSURES. J.Amoignon and G.Mongodin.
Vide, Vol. 12, 371-6 (Sept.-Oct., 1957). In French and English.

An ionic resonance spectrometer, virtually a miniature cyclotron, constructed for the analysis of residual gases is described. Its resolution limit is mass 60. Details of its test on an Edwards pumping system and its calibration are given. During the first few hours of continuous pumping water vapour predominates in the residual vacuum and even after 20 hours the partial pressure of water vapour is still ten times that of carbon dioxide. S.Weintroub

533.59 : 537.534.3

2867. A THEORETICAL STUDY OF AN ION-RESONANCE SPECTROMETER. J.Amoignon and G.Rommel.
Vide, Vol. 12, 377-82 (Sept.-Oct., 1957). In French.

A mass-spectrometer for analysis of residual gas at very low pressures is considered. The ion paths in a uniform magnetic field are calculated as a function of frequency of a small uniform r.f. field perpendicular to the magnetic field. The conditions are found for reaching a target distant R_0 from the magnetic axis along which the ions are produced, and hence the resolving power $\Delta m/m$. The initial velocities of ions were expected, and found experimentally, to be unimportant; but it was found that residual gas scattering made a "dee" system necessary, giving non-uniform electric fields but some electric focusing. Under certain conditions the uniform-field analysis is still valuable. J.H.Fremlin

533.6

2868. VISCOSITY OF MIXTURES OF H_2 AND HD BETWEEN 300 AND 14°K. A.O.Rietveld and A.van Itterbeek.
Physica, Vol. 23, No. 9, 838-42 (Sept., 1957).

The coefficients of viscosity of mixtures of gaseous hydrogen and its isotope HD, as well as of the pure components, were determined between 300 and 14°K, using the method of the oscillating disk. The measurements on the mixtures were carried out as a function of the HD concentration. The ration η_{HD}/η_{H_2} is calculated. Below 70°K this ratio decreases. A.

533.6.011

2869. THEORY OF A GAS STREAMING IN A POROUS MEDIUM IN THE NEAR-KNUDSEN DOMAIN OF PSEUDO-MOLECULAR FLOW. B.V.Deryagin and S.P.Bakanov.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 2, 267-70 (1957). In Russian.

Criteria are formulated for pseudo-molecular flow in the near-Knudsen domain. The transition to true molecular flow is affected by porosity to a degree depending on the ratio of pore diameter to molecular dimension. J.W.Gardner

533.6.011.31

2870. APPLICATION OF THE THIN-WING-EXPANSION METHOD TO THE COMPRESSIBLE FLOW PAST PROFILES OF ARBITRARY SHAPE. H.Naruse.
J. Phys. Soc. Japan, Vol. 12, No. 8, 959-68 (Aug., 1957).

The formulae for the velocity distribution over the surface of an obstacle of arbitrary shape are given to the transonic third approximation by the use of Imai's thin-wing-expansion method. These formulae are applied to the flow past an elliptic cylinder, and it is found that the results are in accord with the other results within the order of the approximation used. Further, these formulae, together with the Ψ- and the $\Phi\Psi$-procedures, are applied to the flow past Tomotika–Tamada's profiles. Calculated velocity distributions are compared with Tomotika–Tamada's exact solutions, as well as with Takami's numerical results obtained by various methods of approximation. These formulae seem to be very useful, because their convergency and accuracy are very good up to considerably high Mach numbers. A.

533.6.011.4

2871. TRANSITIONAL CORRECTION TO THE DRAG OF A SPHERE IN FREE MOLECULE FLOW.
R.M.L.Baker, Jr and A.F.Charwat.
Phys. Fluids, Vol. 1, No. 2, 73-81 (March-April, 1958).

The mechanics of collisions between molecules in front of a sphere moving at hypervelocity through a rarefied atmosphere are analysed. The study is concerned with the "transitional" regime in which molecules emitted by the surface begin to shield the body from the oncoming Newtonian stream and the net drag decreases from its free-molecular value. It is found that a simplified but physically significant model can be formulated, and that it leads to a dependence of the drag coefficient on two transition parameters. These can be interpreted as the Reynolds number and the surface-to-free stream temperature ratio. The predictions of this theory agree qualitatively and in order of magnitude with observations. A.

533.6.08 : 536.51

2872. A RHODIUM-PLATED KATA THERMOMETER FOR MEASURING TRUE AIR VELOCITY. W.Koch and D.Kaplan.
J. sci. Instrum., Vol. 35, No. 1, 8-11 (Jan., 1958).

Rhodium-plated kata-thermometers were developed because Rh is a more stable coating than Ag. They were tested in non-turbulent air streams at the National Physical Laboratory, Teddington. Formulae for estimating true air velocities from cooling rates of the kata-thermometers are given. Accompanying graphs facilitate the calculation of velocities. Cooling of the instruments is not directly related to the square root of air speed at low velocities. From zero speed (still air) up to a velocity of 0.5 m/s, the plot of the cooling rate v. velocity is a parabola, and from 0.5 to 1.3 m/s a straight line. A.

533.6.08 : 551.508.5

2873. A LINEAR, UNIDIRECTIONAL ANEMOMETER OF RAPID RESPONSE. R.J.Taylor.
J. sci. Instrum., Vol. 35, No. 2, 47-52 (Feb., 1958).

A heated wire dissipating constant power causes temperature changes in the air moving past it, which vary approximately inversely as the wind speed. These temperature changes are detected by a thermometric bridge and, by means of a circuit with feedback control, an electrical signal is constructed that is linearly related to the velocity. The resulting anemometer is sensitive only to the normal velocity component and, by combining two such anemometers, changes in sign of this component can be accommodated. Four fine wires (0.0005 in tungsten or nickel) are used, but they can be replaced if damaged without affecting the calibration. The time constant of the instrument is about 0.3 sec at a wind speed of 0.5 m/sec, and decreases somewhat at higher speeds. A.

MOLECULAR THEORY OF GASES

533.7

2874. COLLISION INTERFERENCE EFFECTS IN A BOSE–EINSTEIN GAS. P.G.Harper.
Physica, Vol. 24, No. 3, 177-84 (March, 1958).

Possible interference effects between successive binary collisions in a Bose–Einstein assembly of interacting particles are examined by carrying perturbation treatment to fourth order. It is concluded that the Boltzmann equation is insufficient to describe the rate of change of the ground state occupation number in the condensed state. A.

533.7

2875. KINETIC THEORY OF MODERATELY DENSE GASES.
R.F.Snider and C.F.Curtiss.
Phys. Fluids, Vol. 1, No. 2, 122-38 (March-April, 1958).

The theory is based on a modified Boltzmann equation, which takes into account the "collisional transfer" of momentum and energy. The theory applies to pure gases made up of spherical molecules, and the effect of multiple collisions is neglected. The Boltzmann equation is solved by a perturbation method which is applicable near equilibrium. Expressions for the flux coefficients, i.e., the thermal conductivity, bulk, and shear viscosity are obtained from this solution and these are in turn evaluated for a rigid sphere potential. A.

533.7 : 537.52

THE NATURE AND PROPERTIES OF ELECTRON "GASES". See Abstr. 2341

533.7 : 532.7 : 530.162

STATISTICAL MECHANICS OF FLUIDS. See Abstr. 2813

533.7 : 532.7

CORRELATIONS IN QUANTUM FLUIDS. See Abstr. 2850

533.75 : 536.71

2876. AN OVERALL TEST OF EQUATIONS OF STATE OF FLUIDS. N.Davy and B.M.Bell.
Brit. J. appl. Phys., Vol. 9, No. 1, 27-30 (Jan., 1958).

An equation of state of a fluid can usually be expressed in the form $f_1(V,T) = P$. When the reduced form of the equation exists, it may be expressed as $f_2(v,t) = p$, where p, v and t are the reduced

values of P, V and T. Since the critical volume cannot be measured with precision, the recent fashion is to use, instead of v, the accurately obtainable pseudo-reduced volume ϕ, leading to a reduced equation $f_3(\phi,t) = p$. It is now suggested that a calculation and plot of the quantity $Y = 100[f_3(\phi,t)/p - 1]$ against $X = p$ (t constant) or $X = t$ (p constant), using experimental values of p, ϕ and t for some real fluid, will reveal in a quantitative manner the discrepancy between the experimental behaviour of that fluid, and of a fluid obeying the particular equation of state under consideration. A set of graphs at various constant temperatures or pressures may be drawn. The fluid considered is CO_2. A.

VIBRATIONS. ACOUSTICS

534.01

2877. SOME REMARKS ON FOUR-POLE PARAMETERS. G.S.Bennett.
J. Acoust. Soc. Amer., Vol. 30, No. 1, 83 (Jan., 1958).

This is a short note replying to a paper by Molloy (see Abstr. 1558/1957) drawing attention to the need for care in ensuring that the conditions of blocked or free action are satisfactorily met in terms of the nature of the vibrational circuit and the measuring devices used. Methods by which some of the conditions can be met are suggested. H.J.H.Starks

534.121.2

2878. VARIATIONAL TREATMENT OF ARBITRARY MASS-LOADED MEMBRANES. E.T.Kornhauser and D.B.Van Hulsteyn.
J. Acoust. Soc. Amer., Vol. 29, No. 11, 1204-5 (Nov., 1957).

A variational principle applicable to mass-loaded membranes of arbitrary shape is used to demonstrate the validity of several conclusions inferred in a previous paper (Abstr. 147/1954) from the rigorous results for the centre-loaded circular membrane. A.

534.121.2

2879. VARIATIONAL METHOD FOR THE VIBRATIONS OF THE INDIAN DRUMS. T.Sarojini and A.Rahman.
J. Acoust. Soc. Amer., Vol. 30, No. 3, 191-6 (March, 1958).

The frequencies of the lower modes of vibration of the Indian drums, the right and left-hand thabalas (which have circular drumheads loaded concentrically in the former, and eccentrically in the latter), were computed by the method of variation of parameters incorporating the variation of the surface density of the drumheads in the normalizing integral. The boundary value problem is first formulated in terms of a modified form of bipolar coordinates suitable for the eccentrically loaded left-hand thabala, the boundary-value problem of the right-hand thabala being obtained as a special case when the eccentricity parameter vanishes. It is then shown that the harmonic character of the modes of vibration is primarily determined by the ratio of the radii of the loaded and unloaded regions, the eccentric position of the loaded region in the left-hand thabala merely bringing about a small separation between the frequencies of the even and odd modes. The computed frequencies are compared with previous calculations. For the right-hand thabala, where exact values are known, the agreement is as good as 1%; and for the left-hand thabala, where only approximate values are known, the agreement is about 10%. A.

534.13

2880. EXPERIMENTAL STUDY OF MECHANICAL DISSIPATION IN BUTT-JOINED ADP CRYSTAL PLATES. B.J.Faraday and D.J.G.Gregan.
J. Acoust. Soc. Amer., Vol. 29, No. 9, 1001-4 (Sept., 1957).

In the design of resonant piezoelectric transducers of conventional type which utilize zxt 45 ammonium dihydrogen phosphate (ADP) plates vibrating longitudinally, the low-frequency limit is determined by the transverse dimensions of the mother block from which individual plates are cut. The growth habit of ADP, however, precludes significant accretion in the lateral direction. By cementing single crystal plates end to end, i.e., butt-joining, greater crystal lengths are produced and proportionately lower frequencies are attained. The dissipation factor, the reciprocal of the mechanical Q, was measured for variable thickness of bond, keeping the position constant, and for variable position, keeping the thickness constant. These tests indicated that the thickness should be kept at a minimum and that the bond should be located away from the position of the antinode of stress and strain. A.

534.13 : 534.21

2881. SURFACE MOTIONS OF A THICK PLATE. L.Knopoff.
J. appl. Phys., Vol. 29, No. 4, 661-70 (April, 1958).

The motion of a thick elastic plate, infinite in two dimensions and bounded by air on the two parallel faces, is studied. The plate is excited at a point on one face, as in Lamb's problem, by a force impulsive in time, and directed normal to the surface. The early motions of this surface have been described by Lamb. An exact solution, in closed form, for the motion of the opposite face is available only at the epicentre. The motions at all other points are evaluated by a seismic model. At the epicentre, the measurements and the calculations are in agreement; at this point a strong P pulse and a weaker S pulse are observed. This S phase has a waveform, for short pulses, which is the time integral of the waveform of the P phase. Off the axis of symmetry, the form of the S pulse is the same as that of the P pulse. The S pulse becomes quite strong away from the epicentre, attaining an amplitude of nearly four times that of the P pulse at about 45° in the Solenhofen limestone plate. A bodily S-surface P phase, whose existence is in agreement with predictions based upon geometrical arguments is discerned at angles exceeding the critical angle. A simplified description of the early motion of the reverse face may be constructed. This simplified response is a useful tool which may be used to reduce the complexity of the calculations encountered in other boundary value problems. A.

534.132

2882. VIBRATIONS OF FERROELECTRIC CYLINDRICAL SHELLS WITH TRANSVERSE ISOTROPY. I. RADIALLY POLARIZED CASE. J.F.Haskins and J.L.Walsh.
J. Acoust. Soc. Amer., Vol. 29, No. 6, 729-34 (June, 1957).

Expressions for the coupled mechanical vibrations and electrical admittance of ferroelectric tubes having transverse isotropy are derived and the results supported with experimental data. Coupled modes in radially polarized barium titanate tubes are examined as a function of length to radius ratio. A frequency-dependent expression is given for the admittance in terms of electromechanical coupling, capacitance, and tube length. Results permit close prediction of resonant frequencies. An optimum length to radius ratio of 2.9 is indicated for maximum electro-mechanical coupling with the gravest radial mode in a radially polarized tube. A.

534.14 : 535.42

2883. EXCITATION OF HYPERSONIC VIBRATIONS IN QUARTZ. K.N.Baranskii.
Kristallografiya, Vol. 2, No. 2, 299-302 (1957). In Russian.

Results are reported for the diffraction of light by the hypersonic "grating" in quartz vibrating at about 10^9 c/s. See also Abstr. 8468 (1957). R.F.S.Hearmon

534.152 : 535.421

2884. IMPROVED LIGHT VALVE FOR THE PHOTOGRAPHIC RECORDING OF VIBRATIONS. G.M.Sreekantath.
J. Acoust. Soc. Amer., Vol. 29, No. 9, 1034-5 (Sept., 1957).

A scheme is described for modulating a beam of light using a transmission grating. Two identical coarse gratings with opaque and transparent elements of equal width "a" are mounted a certain distance apart and suitably disposed relative to a narrow, vertical, illuminated slit. A lens system produces diffraction spectra of different orders at its focal plane, and the zero order is isolated by a slit which is focused on the recording film. The vibrations to be measured are transmitted to one of the gratings. The maximum amplitude of the vibrations that can be recorded is about a/4. Variable density records are obtained. H.J.H.Starks

534.154 : 534.222.2 : 621.317.39

2885. RESPONSE SPECTRA BY MEANS OF OSCILLOGRAPH GALVANOMETERS. R.W.Conrad and I.Vigness.
J. Acoust. Soc. Amer., Vol. 29, No. 10, 1110-15 (Oct., 1957).

A response spectrum (shock spectrum) is the response of a series of single-degree-of-freedom systems, of given damping, to a shock or vibratory motion, as a function of the frequencies of the simple systems. An oscillographic galvanometer is a single-degree-of-freedom system having a rotational response to an exciting current. If the exciting current is made proportional to the amplitude of the motion, the response of the galvanometer to the current will be proportional to that of a single-degree-of-freedom system to the motion, provided their natural frequencies and damping properties are the same. A commercial galvanometer-type oscillograph was obtained having twelve undamped galvanometer elements with natural frequencies in the range from 10 to 2500 c/s. Damping, by electrical means, was made adjustable between about 3 and 50% of

critical. Associated circuitry was constructed so that electrical play-back of recordings of shock and vibratory motions can be conveniently analysed. Calibration techniques are described and examples are given of the analysis of simple and complex shock motions. A.

534.2

2886. NOTE ON A LETTER BY GREENSPAN. H.Deresiewicz. REPLY TO LETTER BY DERESIEWICZ. M.Greenspan.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1375-6, 1376 (Dec., 1957).

Deresiewicz answers some criticisms by Greenspan regarding the widespread acceptance of certain Laplacian arguments (see Abstr. 9571/1957), and Greenspan replies. H.J.H.Starks

534.21

2887. OPPOSITELY DIRECTED PLANE FINITE WAVES. R.D.Fay.
J. Acoust. Soc. Amer., Vol. 29, No. 11, 1200-3 (Nov., 1957).

The analysis is carried out in terms of particle velocities expressed as Mach numbers. In general, the pertinent quantities are expressed in relation to the infinitesimal values by a power series of these Mach numbers in which two powers are retained. To this order of approximation, the particle velocity is the vector sum of the particle velocities of the isolated component waves, and the speed of propagation in each direction has an increment proportional to the vector difference of these particle velocities. The general behaviour of the sound field may be predicted from these two relations. A.

534.21

2888. VIBRATIONS OF CYLINDRICAL SHELLS. P.W.Smith, Jr.
J. Acoust. Soc. Amer., Vol. 30, No. 1, 83-4 (Jan., 1958).

A recent paper by Mirsky and Herrmann (Abstr. 2189/1958) is criticized on the grounds that, in attempting to extend to the more general vibrations of shells the approximation method used in analysing the high-frequency behaviour of beams, plates and axially symmetric waves in cylindrical shells, discrepancies have arisen between the new results and those expected from the bending theory analysis. The nature of these discrepancies is such as to throw serious doubt on the new results. H.J.H.Starks

534.213

2889. RAY THEORY SOLUTION FOR THE SOUND INTENSITY IN WATER DUE TO A POINT SOURCE ABOVE IT. A.A.Hudimac.
J. Acoust. Soc. Amer., Vol. 29, No. 8, 916-17 (Aug., 1957).

For a given height of source and depth of point of observation, the intensity and lateral range are given by a pair of parametric equations in terms of the angle of incidence. An example is given for which iso-intensity lines are plotted. A striking feature is the way in which intensity increases appreciably with depth (except directly below the source). A.

534.213

2890. PROPAGATION OF A PRESSURE TRANSIENT IN A TWO-LAYER, LIQUID MODEL. W.C.Knudsen.
J. Acoust. Soc. Amer., Vol. 29, No. 8, 918-24 (Aug., 1957).

The propagation of a pressure transient in a model consiting of a surface layer of liquid overlying a thick (essentially semi-infinite) bottom layer of liquid has been investigated experimentally. Attention is restricted to the behaviour in and near the surface layer at a range large compared with the depth of the surface layer. The results have been analysed to determine the group velocity curve, variation of pressure amplitude with source and receiver depth, and the rate of amplitude decay with range for the maximum envelope amplitude. The results are found to be in general agreement with the theory of C.L.Pekeris. In addition, the rate of decay with range for the first peak amplitude was measured and found to be r^{-2} within experimental error. A.

534.22 : 533.7

2891. ULTRASONIC VELOCITY AND THERMAL RELAXATION IN DRY CO_2 AT MODERATE PRESSURES.
M.C.Henderson and L.Peselnick.
J. Acoust. Soc. Amer., Vol. 29, No. 10, 1074-80 (Oct., 1957).

The velocity and absorption of ultrasound in dry CO_2 were measured along the 50.8° isotherm with a Hubbard-type, variable-path, recording acoustic interferometer at six frequencies from 300 kc/s to 7 Mc/s and from 0.3 to 250 atm, i.e. up to liquid densities. Velocity dispersion is clearly shown, in addition to the change in velocity attributable to the non-ideality of the gas. The values of the frequency/density ratio f/ρ, at which the transition from V_0^2 to V_∞^2 is half-completed as the pressure is lowered, and at which the maximum absorption per wavelength occurs, were measured whenever possible. From these determinations the relaxation time of the gas was determined as a function of the density. It proves to be inversely proportional to the density up to the highest density reached (0.8 g/ml), indicating that ternary collisions have not become important and that the number of binary collisions required to excite the internal vibrations does not vary with density. At 50.8° and 1 atm the relaxation frequency $1/2\pi\tau$ is about 26 kc/s and the number of collisions required to excite the molecule is 48 500. The extra absorption (in excess of the classical) remains a consequence of thermal relaxation up to liquid densities, and no new mechanism need be postulated to explain it. Further work at higher densities and other temperatures is in progress. A.

534.22

2892. ULTRASONIC PULSE TECHNIQUE FOR MEASURING ACOUSTIC LOSSES AND VELOCITIES OF PROPAGATION IN LIQUIDS AS A FUNCTION OF TEMPERATURE AND HYDROSTATIC PRESSURE. H.J.McSkimin.
J. Acoust. Soc. Amer., Vol. 29, No. 11, 1185-92 (Nov., 1957).

A fixed path ultrasonic unit operating in the frequency range from 20 to 200 Mc/s is described, which can be used for measuring acoustic wave velocities and losses in liquids as a function of temperature and hydrostatic pressure. A simple phase balance technique insures a high order of accuracy for velocities determinations. Illustrative data for carbon tetrachloride, Dow Corning DC-703 and DC-200 silicone fluids, and water are shown. Determination of freezing points of liquids using ultrasonic waves for indication is also discussed briefly. A.

534.22

2893. MEASUREMENT OF SONIC VELOCITY IN WAX CYLINDERS. W.G.Clay and W.S.Partridge.
J. Acoust. Soc. Amer., Vol. 30, No. 2, 151 (Feb., 1958).

The measurements were made at unspecified audio frequencies and at temperatures from 0° to 28°C, using a gramophone pick-up to determine node-to-antinode spacing in standing waves. The velocity falls linearly with increasing temperature.

H.D.Parbrook

534.22 : 611.91

2894. ON THE PROPAGATION VELOCITY OF SOUND IN THE HUMAN SKULL. J.Zwislocki.
J. Acoust. Soc. Amer., Vol. 30, No. 3, 186-7 (March, 1958).

Measurements of the propagation velocity of flexural waves in the human skull performed in three different studies are discussed and compared. The analysis leads to the conclusion that the existing discrepancies may be due to individual differences in skull thickness. For frequencies around and above 1000 c/s the highest measured velocity was 570 m/sec, and the lowest 260 m/sec. A.

534.22

2895. ULTRASONIC DISPERSION IN OXYGEN. J.V.Connor.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 297-300 (April, 1958).

The velocity of ultrasonic waves in oxygen was measured at 40.6°C and 2 Mc/s, with pressures ranging from one atm to 0.35 cm Hg. Velocity dispersion was found at the lower pressures and is accounted for in part by rotational relaxation and at the lower pressures by the onset of the Stokes type of dispersion. The midpoint of the dispersion curve lies at 122 Mc/s per atm, which corresponds to a relaxation time of 21.76×10^{-10} sec and to 13 as the average number of collisions necessary for the energy exchange. Consideration of the added translational dispersion effect establishes 12 as the average rotational collision number. A Hubbard-type sonic interferometer was used together with a strip recorder, several different tuning techniques being employed at the lowest pressures. A.

534.22 : 532.7

2896. SPEED OF SOUND IN WATER BY A DIRECT METHOD. M.Greenspan and C.E.Tschiegg.
J. Res. Nat. Bur. Stand., Vol. 59, No. 4, 249-54 (Oct., 1957).

The speed of sound in distilled water was measured over the temperature range 0° to 100°C with an accuracy of 1 part in 30 000. The results are given as a fifth-degree polynomial and in tables. The water was contained in a cylindrical tank of fixed length, terminated at each end by a plane transducer, and the end-to-end time of flight of a pulse of sound was determined from a measurement of the pulse-repetition frequency required to set the successive echoes into time coincidence. A.

534.22 : 536.48

2897. MEASUREMENTS ON THE VELOCITY OF ULTRASONIC WAVES IN LIQUID HELIUM.
A.van Itterbeek, G.Forrez and M.Teirlinck.
Physica, Vol. 23, No. 10, 905-6 (Oct., 1957).

The velocity of ultrasonic waves was determined at frequencies

226, 523, 800 and 1455 kMc/s at 0.985°K. The velocity as a function of frequency is constant within 1/2400. A.

534.22 : 532.7 : 536.48

2898. DISPERSION OF SOUND IN A FERMI LIQUID. I.M.Khalatnikov and A.A.Abrikosov.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 110-15 (1957). In Russian.

Absorption and dispersion of sound waves in a Fermi liquid is studied on the basis of Landau's theory of a Fermi liquid. Particular calculations are carried out for the case of liquid He^3. A.

534.22 : 534.23

2899. SOUND PROPAGATION IN GASES AT HIGH FREQUENCIES [100 TO 600 kc/s] AND VERY LOW PRESSURES. E.Meyer and G.Sessler.
Z. Phys., Vol. 149, No. 1, 15-39 (1957). In German.

Sound absorption and velocity values in argon, air and hydrogen were measured in the frequency/pressure range 10^7 to 10^{11} cycles $sec^{-1}atm^{-1}$ using condenser transducers (E.Meyer, Nuovo Cimento Suppl., Vol. 7, No. 2, 248-54, 1950). Between 10^7 and 10^8 cycles $sec^{-1}atm^{-1}$ the values in argon agree with the Stokes–Kirchhoff theory; in air with the Burnett theory. Between 10^8 and 2×10^9 cycles $sec^{-1}atm^{-1}$, the values in argon and air and the velocity values in hydrogen agree better with the Burnett theory, and absorption measurements in hydrogen with the "super" Burnett theory. From 10^{10} to 10^{11} cycles $sec^{-1}atm^{-1}$ the values agree with a molecular kinetic theory. H.D.Parbrook

534.222.2

2900. SOME SECONDARY EFFECTS RELATED TO IMPACT WAVE FORMS. J.S.Nisbet and J.N.Brennan.
J. Acoust. Soc. Amer., Vol. 29, No. 7, 837-42 (July, 1957).

This paper considers changes in the shock spectrum that may arise from minor variations in the form of an applied pulse. In addition to the rise and decay times the nature and symmetry of the discontinuities has a profound effect on the high-frequency components. The selection of parameters in the design of a square wave accelerator is discussed. The effects of shock-excited resonances in a machine are investigated, together with methods of minimizing their effect. A.

534.222.2 : 536.424.1 : 539.21

2901. MULTIPLE SHOCK PRODUCTION. W.E.Drummond.
J. appl. Phys., Vol. 28, No. 9, 998-1001 (Sept., 1957).

A dynamical theory is developed for the explosive production of multiple shocks in metals which undergo a phase transition. In addition to the formation of two compressive shocks, it is found that a rarefaction shock is also produced, which will overtake one of the compressive shocks. A.

534.222.2 : 532.5 : 538.3

2902. AN EXPERIMENT ON THE INTERACTION BETWEEN A PLANE SHOCK AND A MAGNETIC FIELD. K.Dolder and R.Hide.
Nature (London), Vol. 181, 1116-18 (April 19, 1958).

In order to observe hydromagnetic behaviour, experiments were performed on high-speed, high-temperature shock waves, in a shock tube which passes through an intense magnetic field. The simple geometry allows clear pictures to be taken. These are given, with data. S.F.Edwards

534.222.2

2903. AN EXPERIMENTAL STUDY OF PULSE PROPAGATION IN ELASTIC CYLINDERS. D.Y.Hsieh and H.Kolsky.
Proc. Phys. Soc., Vol. 71, Pt 4, 608-12 (April, 1958).

The distortion of longitudinal pulses in elastic cylinders resulting from the effects of lateral inertia is discussed in terms of the Pochhammer treatment. The experimentally observed displacement–time curve produced at one end of a steel cylinder when a small explosive charge is detonated at the opposite end is compared with that obtained theoretically using Fourier synthesis. It is found that only the fundamental mode of propagation need be considered in predicting the pulse shape under such conditions. A.

534.222.2

2904. INTERACTION OF CYLINDRICAL SOUND WAVES WITH A STATIONARY SHOCK WAVE. W.R.Johnson and O.Laporte.
Phys. Fluids, Vol. 1, No. 2, 82-94 (March-April, 1958).

The interaction is investigated by a method analogous to that used by Weyl in his treatment of the propagation of radiowaves over the surface of a plane earth. The incident cylindrical sound-wave is represented as a superposition of plane sound-waves of varying direction. Each of the plane waves in this superposition interacts with the shock giving rise to a previously determined distortion of the shock front and reflected or refracted wave field; the cylindrical wave causes a disturbance which may be written in integral form as a superposition of these plane waves. The resulting interaction integrals are evaluated asymptotically to give explicit formulae for the distortion of the shock, the sound field, and the entropy-vorticity wave. A.

534.222.2

2905. FAR TRANSMISSION OF AIR BLAST WAVES. E.F.Cox.
Phys. Fluids, Vol. 1, No. 2, 95-101 (March-April, 1958).

A semi-acoustic theory of blast energy propagation, incorporating Sachs' scaling modified for altitude of observation, gives excellent agreement with experiments, providing Hilliar's similarity principle is restricted to similar ambient (weather) conditions. Comparisons between this theory and experiments are made for free air (no reflections) blast pressures; ground-level blast pressures in an isothermal, still atmosphere; and blast pressures under a linear temperature inversion. A.

534.222.2

2906. ON THE STRUCTURE OF THE FRONT OF STRONG SHOCK WAVES IN GASES. Yu.P.Raĭzer.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1528-35 (1957). In Russian.

The internal structure of the front of shock waves which takes radiation into account is investigated. Approximate solutions of the equations are found. The profiles of the hydrodynamical quantities, density and radiation flux are constructed. A.

534.222.2 : 535.33.03

2907. ON THE BRIGHTNESS OF STRONG SHOCK WAVES IN AIR. Yu.P.Raĭzer.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 101-9 (1957). In Russian.

The emission and absorption of light at high temperatures in a shock-wave front in air is considered. The dependence of the brightness of the shock-wave front on its amplitude is derived. A.

534.23

2908. SOUND AND ULTRASOUND ABSORPTION RESULTING FROM HEAT RADIATION. A B.Bhatia.
J. Acoust. Soc. Amer., Vol. 29, No. 7, 823-4 (July, 1957).

Following a suggestion by Markham, Beyer and Lindsay (Abstr. 4971/1952), the Stefan-Boltzmann radiation law is applied to estimate the attenuation of approximately plane compression waves resulting from heat radiation. The attenuation is found to be independent of the frequency of the compression waves in the entire relevant frequency range and inversely proportional to a linear dimension of the wave fronts. At ordinary temperatures, this attenuation is negligible compared to that due to thermal conduction and viscosity, verifying the results of Rocard and Rayleigh. In gases at temperatures of 1000°K or more, however, the attenuation due to heat radiation is not entirely negligible under certain conditions. A.

534.23

2909. ULTRASONIC SHEAR AND COMPRESSIONAL RELAXATION IN LIQUID GLYCEROL. R.Piccirelli and T.A.Litovitz.
J. Acoust. Soc. Amer., Vol. 29, No. 9, 1009-20 (Sept., 1957).

Relaxation of the real parts of the shear and compressional moduli of liquid glycerol was investigated using ultrasonic pulse techniques. Measurements of the decibel loss per echo for a glycerol-quartz interface were made at frequencies from 15 to 85 Mc/s over the temperature range from +70°C to −40°C. Measurements of the velocity of longitudinal waves in glycerol were made at frequencies from 1 to 55 Mc/s over the temperature range from +50° to 80°C. The limiting values of the real parts of the shear and compressional moduli were studied and compared over the temperature range. The behaviour of the relaxational parts of the real parts of the shear and compressional moduli cannot be quantitatively explained by either classical or single relaxation time theory. A distribution of relaxation times is shown to be adequate to explain both the shear and compressional relaxations. The average compressional relaxation time is found to be 0.81 × the average shear relaxation time. A.

534.231

2910. ACOUSTICAL RADIATION FROM A POINT SOURCE IN THE PRESENCE OF TWO MEDIA. D.I.Paul.
J. Acoust. Soc. Amer., Vol. 29, No. 10, 1102-9 (Oct., 1957).

Two semi-infinite isotropic media (porous or non-porous) are separated by a plane interface. A simple point source of sound is embedded in either of the media. Expressions for the resultant wave function are obtained by the method of steepest descents as modified by Banos and Wesley. In particular, two different asymptotic solutions are presented. The first solution is valid in the vicinity of the interface. The expansions, calculated out to three terms, yield the

wave solution as a continuous function of the parameter of the two media and the space coordinates for horizontal ranges beginning at small distances from the source and extending to infinity. It is shown that a surface wave exists and that this wave gradually disappears when the horizontal range becomes sufficiently large. The second solution consists of a simple three-term asymptotic expansion valid in the vicinity of the vertical axis. The mathematical treatment uses a new path of integration not found in the literature on this problem. A.

534.232 : 621.396.677

2911. THEORY OF TIME-AVERAGED-PRODUCT ARRAYS. A.Berman and C.S.Clay.
J. Acoust. Soc. Amer., Vol. 29, No. 7, 805-12 (July, 1957).

The mathematical analysis of the directional characteristics of linear additive arrays is given in a polynomial representation. The result of multiplying and taking a time average of the outputs of several detectors also has directional characteristics that may be expressed as polynomials. It is shown that the same directional characteristics may be obtained from multiplicative arrays having a small number of detectors as with an additive array with a large number of elements. The length of the multiplicative array is about half the length of the additive array having the same directional characteristics. A.

534.232

2912. SELF-RECIPROCITY TRANSDUCER CALIBRATION IN A SOLID MEDIUM. R.M.White.
J. Acoust. Soc. Amer., Vol. 29, No. 7, 834-6 (July, 1957).

The applicability of the self-reciprocity technique to the calibration of a reversible compressional-wave transducer in a solid medium is demonstrated, and a method is described of correcting for the electrical loading by the source signal generator of the transducer being calibrated. A.

534.232 : 621.315.59 : 621.317.39

2913. USE OF PIEZORESISTIVE MATERIALS IN THE MEASUREMENT OF DISPLACEMENT, FORCE, AND TORQUE. W.P.Mason and R.N.Thurston.
J. Acoust. Soc. Amer., Vol. 29, No. 10, 1096-101 (Oct., 1957).

The use of piezoresistive materials as strain gauges and in the measurement of displacement, force and torque is discussed generally. A torsional transducer, which was constructed from n-type Ge, is described, and the experimentally obtained voltage-torque characteristic is given. A.

534.232 : 621.395.623.7

2914. PANORAMIC REPRESENTATION OF THE SOUND FIELD. G.G.Sacerdote and C.Bordone-Sacerdote.
J Acoust. Soc. Amer., Vol. 29, No. 11, 1165-8 (Nov., 1957).

Recording, by means of a sonagraph, the sound pressure generated by a turning loudspeaker, fed by white noise, a synthetic representation can be given of the directional behaviour of the loudspeaker. One can study the behaviour of reflecting surfaces and the directivity of a microphone by the same method. A.

534.232

2915. FIELD OF A SPATIALLY EXTENDED MOVING SOUND SOURCE. H.L.Oestreicher.
J. Acoust. Soc. Amer., Vol. 29, No. 11, 1223-32 (Nov., 1957).

The rigorous determination of the field of a spatially extended sound source moving with subsonic speed in a viscous compressible gas is formulated as an initial-boundary value problem of a system of linear partial differential equations. This system reduces to a single equation of the second order with variable coefficients, if the medium is a perfect gas and the motion of the gas around the source a potential flow. For steady motions and harmonic sources the equation becomes elliptic if time is eliminated. Generalizations of Green's identity and Helmholtz's formula for this partial differential equation allow the representation of the sound field as a series of generalized multi-poles. The field of a sufficiently small source of arbitrary shape with boundary conditions appropriate for the acoustic case and its relation to the concept of a moving simple source, dipole, etc. is investigated. A.

534.232

2916. SUPPLEMENTARY NOTES TO "FIELD OF A SPATIALLY EXTENDED MOVING SOUND SOURCE". H.L.Oestreicher.
J. Acoust. Soc. Amer., Vol. 30, No. 5, 480-1 (May, 1958).

See preceding abstract.

534.232 : 621.395.614

2917. LABORATORY STANDARD CERAMIC MICROPHONE. W.Newitt.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1356-65 (Dec., 1957).

Microphones using $BaTiO_3$ disk ceramics in conjunction with a split-tube diaphragm were designed and constructed. Frequency-response measurements were obtained by use of reciprocity techniques and by comparison with a known standard. Sensitivities from −86 to −88 dB, referred to 1 V dyn^{-1} cm^{-2}, were obtained with a frequency response of ±1 dB from 10 c/s to 30 kc/s. The rugged construction and high stiffness of the microphone make it adaptable for use in high sound-pressures, and for sound measurement in liquids. Theoretical relations pertinent to the development are discussed and a description is given of the construction. Performance data are presented for the microphone and associated electronic equipment. A.

534.232

2918. REVERBERATION CHAMBER STUDY OF THE SOUND POWER OUTPUT OF SUBSONIC AIR JETS. R.V.Waterhouse and R.D.Berendt.
J. Acoust. Soc. Amer., Vol. 30, No. 2, 114-21 (Feb., 1958).

The reverberation chamber technique was used to determine the sound spectra and acoustic power radiated by air jets over a range of subsonic velocities. Different air jets were used with round and square velocity profiles; nozzles of circular cross-section, and nozzles with saw-tooth and corrugated ends were also used. Of these nozzles only the latter type gave a significant (9 dB) reduction in sound power output for a given exit-pressure ratio. A study was made of the limitations of the reverberation chamber technique caused by the absorption in the chamber. When this absorption became considerable, the measurement of sound-pressure level in a circle around the sound source revealed a directional pattern, and the assumption of uniform energy distribution in the chamber became invalid. This situation was noticeable at frequencies above 5 kc/s in the National Bureau of Standards chamber, owing to air absorption. A.

534.24

2919. REFLECTION OF SOUND FROM A SURFACE OF SAW-TOOTH PROFILE. J.M.Proud, Jr, P.Tamarkin and W.C.Meecham.
J. appl. Phys., Vol. 28, No. 11, 1298-301 (Nov., 1957).

A variational method is used to calculate the energy diffracted into the various orders produced when a plane acoustic wave is incident on a periodic, pressure-release surface of saw-tooth shape. The results of companion experiments performed with a cork-covered surface, using the techniques of underwater sound, are also presented. The relative energies reflected in various orders are plotted as a function of the ratio of acoustic wavelength to spatial period of the surface for a range of angles of incidence. Theory and experiment agree within 10% for all angles of incidence examined, and for a large part of the frequency range covered. A.

534.26

2920. DIFFRACTION OF SOUND ON A THIN FINITE ELASTIC CYLINDRICAL SHELL. L.M.Lyamshev.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 2, 271-3 (1957). In Russian.

Mathematical treatment of the diffraction of a plane sound wave on a finite cylindrical shell, whose thickness is only a small fraction of the wavelength of longitudinal waves in the material from which the shell is made. F.Lachman

534.26

2921. SCATTERING OF SOUND WAVES IN IRREGULAR WAVEGUIDES. A.D.Lapin.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 1, 55-8 (1958). In Russian.

Develops a generalized solution of the problem, using the method of Rytov (Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 2, 223, 1937) for calculating the scattered field in the right semi-waveguide. For small irregularities the solution was given in the first approximation of the small-disturbance method by Isakovich (Abstr. 555/1958). The scattered field can be represented as the sum of normal waves of the type corresponding to a waveguide without any irregularities. F.Lachman

534.26

2922. FORWARD SCATTERING OF SOUND IN THE SEA AND ITS CORRELATION WITH THE TEMPERATURE MICROSTRUCTURE. D.C.Whitmarsh, E.Skudrzyk and R.J.Urick.
J. Acoust. Soc. Amer., Vol. 29, No. 10, 1124-43 (Oct., 1957).

Scattering measurements are compared with the predictions of existing theories. The agreement is satisfactory. Measurements of

the temperature microstructure, however, lead to unexpected results, showing that the patch sizes, or scales of patch sizes, are continuously distributed and that the temperature fluctuation increases continuously with range. There seems to be almost perfect agreement with the results of the theory of homogeneous turbulence and the temperature fluctuations in water. This would appear to invalidate the present theories, since a correlation function as defined in the usual sense does not exist. If, however, the correlation function is replaced by a new function in connection with a suitably defined temperature distribution, practically all the results of the current theory can be shown to remain valid, and it becomes possible to explain other items as, for instance, the independence of acoustical scattering with depth, and acoustical predominance of certain patch sizes, which hitherto had not been understood. The acoustically effective patches turn out to be a function of the frequency and range, rather than of the particular conditions of the sea. A.

534.374

2923. ACTIVE, ADJUSTABLE AUDIO BAND-PASS FILTER.
J.R.Macdonald.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1348-56 (Dec., 1957).

The filter has seventh-order Butterworth attenuation characteristics (42 dB/octave slopes), 34 separate high-pass cut-off frequencies between 16.2 and 16 200 c/s, and 34 low-pass cut-offs between 20 and 20 000 c/s. It weighs 6 lb exclusive of power supply and uses six miniature double triodes and no inductors. Its insertion gain is 4.5 dB, its dynamic range exceeds 110 dB, and it will supply more than 50 V r.m.s. output with low distortion. Second-order harmonic distortion is much reduced by running valve heaters at about 3.7 V, leading to greatly increased valve life. Inter-modulation distortion at 10 V r.m.s. output is only 0.065%. A.

534.39

2924. REACTION OF SOUND WAVES AND ITS APPLICATION FOR ABSOLUTE MEASUREMENT OF INTENSITY.
H.Olsen, W.Romberg and H.Wergeland.
Acta polytech., No. 226 (1957) [Phys. incl. Nucleonics, Vol. 3, No. 10] 12 pp. = Tekn. Skr. [Oslo], No. 17.

A derivation — based upon first principles — of the force exerted by sound waves on a fixed body. For the convenience in practical use the case of a rigid sphere is treated in detail, giving the numerical values which are necessary to determine the absolute intensity of a sound wave by means of the thrust it imparts to a probing sphere. A.

534.42 : 534.782

2925. SOUND SYNTHESIZER WITH OPTICAL CONTROL.
O. Fujimura.
J. Acoust. Soc. Amer., Vol. 30, No. 1, 56-7 (Jan., 1958).

A new sound synthesizing system has been devised, which is controlled by an optical programme pattern (similar to the Sonagram). The system employs ADP crystals with different resonance frequencies as the mechanical filter bank with electrical input and optical output. Any electrical wave form can be used as the source signal, and the pitch of voiced sounds can be controlled by a separate pitch channel. The possibilities of development of some variations for the visible speech play-back and a Vocoder system without any electrical filter bank are described. A.

534.612.4

2926. PISTONPHONE WITH DIFFERENTIAL PISTON.
J.Merhaut and M.Vlček.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 263-6 (April, 1958).

The various sources of error in the absolute calibration of standard microphones in a pistonphone are examined. A new differential pistonphone was developed, which enables absolute calibration of microphones with the accuracy 0.1 dB. The design and properties of the instrument are described. A.

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85

534.781 : 612.85

2927. STEREOPHONIC LISTENING AND SPEECH INTELLIGIBILITY AGAINST VOICE BABBLE.
I.Pollack and J.M.Pickett.
J. Acoust. Soc. Amer., Vol. 30, No. 2, 131-3 (Feb., 1958).

The utilization of a particular form of stereophonic information was studied with respect to the intelligibility of a single speech-source heard in the presence of a voice babble of other speakers. The reception of monosyllabic words, presented against a babble of 1, 2, 4 or 7 talkers, was compared under two listening conditions: (1) in the stereophonic listening conditions, one set of background talkers was presented to one earphone, another set of background talkers was presented to the other earphone, and the test words were presented binaurally, in phase; (2) in the control listening condition, only a single set of background talkers and the test words were presented to a single ear. The stereophonic advantage, for 50% word intelligibility, ranged from 12 dB with 1 background voice per channel to 5.5 dB with 7 background voices per channel. A.

534.784

2928. NOTE ON VOWEL DURATION SEEN CROSS-LINGUISTICALLY. S.A.Zimmerman and S.M.Sapon.
J. Acoust. Soc. Amer., Vol. 30, No. 2, 152-3 (Feb., 1958).

An experiment is described to compare the influence of consonants on the duration of preceding, stressed vowels in Spanish and English. Qualitatively, vowels preceding sonants were longer than those preceding surds in both languages, but the differences, as well as the total range of vowel duration, were less for Spanish than for English. It is suggested that the vowel length variations are determined by the extent of sonant-surd contrasts in the language.

T.H.D.Attewell

534.837

2929. SIMPLIFIED NOISE REPORTING. R.W.Young.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 363 (April, 1958).

Comments on a paper on take-off noises from two kinds of aircraft by Miller and Beranek (Abstr. 1579/1958) suggesting that for these noises the use of the A weighting network of the sound-level meter would give equally significant ratings as the proposed (a) "curve of listener response" and (b) 300 to 600 c/s band representative of the complete spectrum, and would have the advantage of including any sound outside this band. H.D.Parbrook

534.837

2930. COMMENTS ON "COMPARISON OF TAKEOFF NOISE CHARACTERISTICS OF THE CARAVELLE JET AIRLINER AND OF THE CONVENTIONAL PROPELLER-DRIVEN AIRLINERS".
K.M.Eldred.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 363-4 (April, 1958).

See Abstr. 1579 (1958). Suggests that additional comparative noise measurements are required to the side of the initial take-off path and under the landing path to cater for communities living nearer to the aerodrome than indicated in the papers; and that further work correlating aircraft noise and community reaction is necessary.

H.D.Parbrook

534.844

2931. ARTIFICIAL REVERBERATION AND THE ACOUSTICS OF [CONCERT] HALLS. J.B.Slavík and J.Tichý.
Slaboproudý Obzor, Vol. 19, No. 2, 96-8 (1958). In Czech.

It is pointed out that the reverberation of a hall should be functionally related to the type of performance (concert, play or opera). The reverberation should be adjusted to suit both the audience and the performer; however, the two requirements are not identical. The only practical method of adjusting the reverberation for the benefit of the audience is the Phillips system, which employs a closed-loop magnetic recorder with several play-back heads and loudspeakers. The system was successfully tried in Czechoslovakia.

R.S.Sidorowicz

OPTICS. RADIATION. SPECTRA

535.14 : 535.41 : 537.312.5

2932. INTERFEROMETRY OF THE INTENSITY FLUCTUATIONS IN LIGHT. I. BASIC THEORY: THE CORRELATION BETWEEN PHOTONS IN COHERENT BEAMS OF RADIATION.
R.H.Brown and R.Q.Twiss.
Proc. Roy. Soc. A, Vol. 242, 300-24 (Nov. 5, 1957).

It is shown by a quantum-mechanical treatment that the emission times of photoelectrons at different points illuminated by a plane wave of light are partially correlated, and identical results are obtained by a classical theory in which the photocathode is regarded as a square-law detector of suitable conversion efficiency. It is argued that the phenomenon exemplifies the wave rather than the particle aspect of light and that it may most easily be interpreted as a correlation between the intensity fluctuations at different points on a wavefront which arise because of interference between different frequency components of the light. From the point of view of the corpuscular picture the interpretation is much less straightforward but it is

shown that the correlation is directly related to the so-called bunching of photons which arises because light quanta are mutually indistinguishable and obey Bose–Einstein statistics. However, it is stressed that the use of the photon concept before the light energy is actually detected is highly misleading since, in an interference experiment, the electromagnetic field behaves in a manner which cannot be explained in terms of classical particles. The quantitative predictions of the theory have been confirmed by laboratory experiments and the phenomenon has been used, in an interferometer, to measure the apparent angular diameter of Sirius: these results, together with further applications to astronomy, will be discussed in detail in later papers. It is shown that the classical and quantum treatments give identical results when applied to find the fluctuations in the photoemission current produced by a single light beam, and the connection between these fluctuations and the correlation between photons in coherent beams is pointed out. The results given here are in full agreement with those obtained by Kahn from an analysis based on quantum statistics: however, they differ from those derived on thermodynamical grounds by Fellgett (Abstr. 2273/1950) and by Clark Jones (Advances in Electronics, 5. New York: Academic Press, 1953) and the reasons for this discrepancy are discussed. A.

535.14 : 535.41 : 537.312.5

2933. INTERFEROMETRY OF THE INTENSITY FLUCTUATIONS IN LIGHT. II. AN EXPERIMENTAL TEST OF THE THEORY FOR PARTIALLY COHERENT LIGHT. R.H.Brown and R.Q.Twiss.
Proc. Roy. Soc. A, Vol. 243, 291-319 (Jan. 14, 1958).

A theoretical analysis is given of the correlation to be expected between the fluctuations in the outputs of two photoelectric detectors when these detectors are illuminated with partially coherent light. It is shown how this correlation depends upon the parameters of the equipment and upon the geometry of the experiment. The correlation may be detected either by linear multiplication of the fluctuations in the two outputs or by a coincidence counter which counts the simultaneous arrival of photons at the detectors. The theory is given for both these techniques and it is shown that they are closely equivalent. A laboratory test is described in which two photomultipliers were illuminated with partially coherent light and the correlation between the fluctuations in their outputs measured as a function of the degree of coherence. The results of this experiment are compared with the theory and it is shown that they agree within the limits of accuracy of the test; it is concluded that if there is any systematic error in the theory it is unlikely to exceed a few parts per cent. A.

535.23.08

2934. A POSSIBLE FAR INFRA-RED DETECTOR USING THERMAL EXPANSION. R.V.Jones.
Proc. Phys. Soc., Vol. 71, Pt 2, 280-3 (Feb., 1958).

An experimental model showed that the linear expansion of a constantan foil will sometimes detect about 10^{-11} W when operating at a bandwidth of 1 c/s. This is about twice the theoretical limit. G.F.Lothian

535.241.3 : 628.9

2935. DEVELOPMENT AND INTERNATIONAL STATUS OF FUNDAMENTAL QUANTITIES AND UNITS IN ILLUMINATION. L.Fink.
Arch. tech. Messen, No. 266 (Ref. V402-2), 49-52 (March, 1958).
In German.

The first half of the paper is a fully documented historical survey of the development of standards of light, leading to the present primary standard. It is followed by a short account of the work that has led to the adoption of the present set of quantities and units. These are listed and their internationally agreed definitions are given. J.W.T.Walsh

535.247.4

2936. CHART CALIBRATION OF A PHOTOGRAPHIC RECORDING MICROPHOTOMETER. M.Gadsden.
J. sci. Instrum., Vol. 35, No. 5, 186-7 (May, 1958).
See Abstr. 6975 (1957).

535.247.4

2937. THE ZEISS RAPID PHOTOMETER AS A RECORDING PHOTOMETER. K.Bahner.
S.B.Heidelberg. Akad. Wiss. (math. nat. Kl.), 1956-57, No. 4, 435-6.
In German.

Technical details are given of a pen-recording form of the Zeiss model II microphotometer, incorporating electronic stabilizing and control units. D.R.Barber

535.317.25

2938. TRANSFORMATION OF INTENSITY MATRIX BY THE TRANSMISSION OF A PUPIL.. H.Gamō.
J. Opt. Soc. Amer., Vol. 48, No. 2, 136-7 (Feb., 1958).

If a coherently illuminated object is imaged by an optical system with a slit-shaped pupil, the image is completely specified by the intensities at a finite number (m) of points, and is given by an Hermitian form obtained from an intensity matrix $A_{m,n}$ and a vector ϕ_n, which expresses the complex amplitudes due to point sources at the m points. It is shown that the effect of re-imaging by a second optical system can be represented by a transformation of ϕ_n, $A_{m,n}$ remaining unchanged. W.Weinstein

535.32 : 539.213.22

2939. CRITICAL STUDY OF THE OPTICAL AND MECHANICAL PROPERTIES OF GLASS FIBERS. S.Bateson.
J. appl. Phys., Vol. 29, No. 1, 13-21 (Jan., 1958).

The cooling rate for fine glass fibres in the 6 to 16 μ diameter range were calculated by means of a new cooling equation. Typical strength v. diameter data are compared with the ratio of quenching time to the Maxwell relaxation t_S/τ. Strength increases rapidly for $t_S/\tau \leq 1.0$ and τ is most probably of the order 10^{-4} sec at 1100°C. The refractive index decreases slightly in the critical region but the change does not indicate a significant rise in the fictive with increased quenching. For this reason structural changes are considered of secondary importance as a factor contributing to high strength. New strength measurements of glass fibres fit a distribution law with reasonable accuracy. It is therefore concluded that the flaw theory of high strength is valid. The influence of "hydrostatic" cooling upon flaw generation is discussed. See also Abstr. 3028 (1958). A.

535.32 : 530.16

KRAMERS–KRONIG RELATIONS IN OPTICAL DISPERSION.
See Abstr. 2811

535.327 : 536.48

2940. THE THERMO-OPTIC BEHAVIOUR OF CALCIUM FLUORIDE. AMMONIUM CHLORIDE AND ZINC-BLENDE AT LOW TEMPERATURES. C.P.Gopalakrishnan.
J. Indian Inst. Sci. A, Vol. 39, No. 8-12 (Jan., 1957).

The values of the proportionate shift with temperature of the ultraviolet dispersion frequencies ($\chi = -\nu^{-1}d\nu/dt$) of CaF_2, NH_4Cl and ZnS were calculated, using the data on the refraction at low temperatures given by Barbaron (Abstr. 2591/1952). It was found that the values of χ tend to very low values near the absolute zero. In the case of ammonium chloride, a new dispersion formula is proposed. In NH_4Cl and CaF_2, the values of χ for the dispersion frequencies obtained from thermo-optic data are compared with the values of χ of the lattice lines obtained from the temperature variation of the Raman spectra. A.

535.327.3 : 535.565

2941. TEMPERATURE VARIATION OF REFRACTIVE INDEX AND OPTICAL ROTATION OF SODIUM CHLORATE. C.P.Gopalakrishnan.
J. Indian Inst. Sci. A, Vol. 39, No. 1, 13-18 (Jan., 1957).

Measurements of the temperature variation of refractive index of sodium chlorate, for the two wavelengths 4358 and 5461 A of Hg, were made in the temperature range from 55° to 200°C. The values of the proportionate shift with temperature of the u.v. dispersion frequencies were evaluated. The thermal variation of optical rotation ($d\rho/dt$) of sodium chlorate for the Hg wavelengths 3650, 4047, 4358, 5461 and 5790 were determined for three temperature ranges using a photoelectric polarimeter. The results are explained using Chandrasekhar's theory (Proc. Indian Acad. Sci. A, Vol. 36, 118, 1952 and Abstr. 9152/1954). A.

535.33

2942. ON THE CALCULATION OF EMISSION SPECTRA IN THE CONFIGURATIONAL CURVE MODEL. D.Curie.
C.R. Acad. Sci. (Paris), Vol. 246, No. 3, 404-6 (Jan. 20, 1958).
In French.

535.33.03 : 621.326.7

2943. SPECTRAL INTENSITY OF A.C. OPERATED TUNGSTEN LAMPS. W.J.Condell and F.T.Byrne.
J. Opt. Soc. Amer., Vol. 47, No. 12, 1135-6 (Dec., 1957).

When a W filament lamp is run on a.c., the cyclic variations of temperature can be calculated. Assuming the emissivity of W to vary linearly with temperature over a limited range, it is possible to derive an equation connecting the intensity at any given wavelength with the temperature of the filament, and thereby deduce the

spectral distribution as measured by a detector with a long time-constant. The differences between the intensities on a.c. and d.c. are tabulated for a microscopic illuminator lamp with a thick filament: they are found to be negligible in the i.r., but greater than 1% in the u.v. J.W.T.Walsh

535.33.07

2944. A 20 FT EBERT GRATING SPECTROGRAPH. G.W.King.
J. sci. Instrum., Vol. 35, No. 1, 11-14 (Jan., 1958).

The design and construction of a new high-resolution spectrograph for the visible and u.v. regions of the spectrum are described. The optical system is that due to Ebert, in which a plane diffraction grating is used in conjunction with a spherical mirror as collimator and camera. This system has several advantages over conventional concave grating mounts; a stigmatic image is formed and wavelength change is accomplished simply by rotation of the grating. The instrument can also be used as a spectrophotometer, and can be adapted for use in the vacuum u.v. A.

535.33.07

2945. A HIGH-RESOLUTION GRATING SPECTROMETER FOR THE INFRA-RED REGION. M.A.Ford, W.C.Price and G.R.Wilkinson.
J. sci. Instrum., Vol. 35, No. 2, 55-8 (Feb., 1958).

A grating spectrometer designed on an Ebert mounting was constructed which, with suitable photoconductive cells and a 6×6 in. N.P.L. grating, gives a resolution of 0.1 cm^{-1} in the range from 6000 to 1700 cm^{-1}. It covers the region 600 to 10 000 cm^{-1} with a single grating, and is as simple to operate as a conventional prism spectrometer. It is intended as a high resolution general purpose instrument which will give a performance an order of magnitude better than that of a prism instrument over the main spectral range. A.

535.33.07

2946. A RECORDING DOUBLE-BEAM ATTACHMENT FOR THE UNICAM TYPE SP500 SPECTROPHOTOMETER. J.L.Hales.
J. sci. Instrum., Vol. 35, No. 4, 142-4 (April, 1958).

Published accounts are reviewed of double-beam attachments for spectrophotometers, for use in the visible and u.v. region. A simple alternate-path unit, incorporating a single type 1.P.28 photomultiplier detector, is described. A ratio-recording amplifying system is employed, and the spectrometer slit width is monitored by a servomechanism to give a constant "reference" output from the amplifier. A compact wavelength drive is incorporated. A.

535.33.07

2947. A SIMPLE GRATING SPECTROMETER FOR SKY-EMISSION STUDIES. R.M.Goody.
Quart. J. Roy. Meteorol. Soc., Vol. 83, 517-21 (Oct., 1957).

A high-dispersion instrument is described for low-temperature emission-spectrometry. The design incorporates a modified Ebert system, with grating and slits at different distances from the two spherical mirrors, and a Golay cell receiver. The transmission of the InSb filter used to screen off unwanted orders of diffraction allows an effective frequency-band (1400 to 700 cm^{-1}) to be used. The resolution achieved is capable of revealing a doublet spacing of 1.4 cm^{-1} at 780 cm^{-1}. D.R.Barber

535.331/.332

2948. COMPARISON OF FIRST, SECOND, AND THIRD APPROXIMATIONS IN BACHER AND GOUDSMIT'S THEORY OF ATOMIC SPECTRA. R.E.Trees.
J. Opt. Soc. Amer., Vol. 48, No. 5, 293-300 (May, 1958).

Andrew and Meissner (Abstr. 949/1958) have shown that a first-approximation formula of the theory of Bacher and Goudsmit leads to better results than a second-approximation formula in several spectra with s and p electrons. The first-approximation formulae are not uniquely defined, and the theory as a whole does not account for the effects of strong configuration-interaction, even when this interaction can be estimated with second-order perturbation theory. In O III experimental data are adequate to demonstrate roughly that errors from these two sources cancel, and thus explain the good agreement. In spectra with s and d electrons, where configuration interaction is less a factor, two first-approximation formulae are shown to yield better results than higher approximations if Racah's modification of the theory of Bacher and Goudsmit is used. The superiority is most marked in spectra of the normal atoms, while in spectra of ions the first three approximations are more or less equivalent and all are very accurate. The Slater theory as recently expanded to include polarization effects (i.e., the linear theory) implies the possibility of getting the best significant agreement in a first approximation, but this is not expected in Racah's modification. It is probably obtained because the parameters increase twice as much with change of a d to an s electron as they do with addition of a d electron and a unit increase in the atomic number. It is not likely that this sort of relationship would be valid in entirely different types of configurations. In the latter it is expected that a second-approximation formula would give best results, but a suitable first-approximation could be found by trial and error. It is shown that the normal spectra follow the same pattern as the spectra of ions if configuration interaction or an irregular variation of the polarization parameters is assumed to cause the d^2 configuration to be 3155 K too high above the ds configuration in Ca I, and 6542 K too high in Sr I. The equivalence of the linear theory and the theory of Bacher and Goudsmit theory is therefore strongly indicated, insofar as effects of third- or higher order perturbations seem not to be observable, even in the normal spectra where they are expected to be strongest. Third- and higher-order approximations may be required when the Bacher and Goudsmit theory is applied in its original formulation, if the variation of parameters of the linear theory is complicated with respect to change in the degree of ionization. In all the formulae for spectra with s and d electrons, the original theory improves, the higher the order of the approximation. However, it is noted that the agreement obtained with the third-approximation formulae is not as good as expected on the basis of the linear theory if a simple power series variation of the parameters is assumed to apply. A.

535.331

2949. SPECTROSCOPIC ISOTOPE SHIFT IN LEAD II.
F.E. Geiger,Jr.
J. Opt. Soc. Amer., Vol. 48, No. 5, 302-3 (May, 1958).

An investigation is made of the spectroscopic isotope shift in the Pb II visible spectrum by using enriched isotopes. The isotope structure of Pb^{204}, Pb^{205} and Pb^{208}, and the hyperfine structure of Pb^{207} in the transitions;

$15\,011\ cm^{-1}\ (6s^2\,7s\,^2S_{1/2} - 6s^2\,7p\,^2P_{1/2}{}^0)$,
$17\,824\ cm^{-1}\ (6s^2\,7p\,^2S_{1/2} - 6s^2\,7p\,^2P_{3/2}{}^0)$,
$18\,032\ cm^{-1}\ (6s^2\,7p\,^2P_{3/2}{}^0 - 6s^2\,7d\,^2D_{5/2})$,
$18\,609\ cm^{-1}\ (6s\,6p^2\,^4P_{5/2} - 6s^2\,5f\,^2F_{1/2}{}^0)$

are analysed with a Fabry–Perot interferometer crossed with a constant-deviation Hilger spectrograph. The samples are excited in a Schüler hollow cathode discharge tube. Spacings between consecutive even isotopes, (205-206), (206-208), the centroid of the odd isotope and the isotope 208 ($207_{c.g.}$-208), and the ratios (204-206)/(206-208), (206-$207_{c.g.}$)/($207_{c.g.}$-208) are given. A.

535.331 : 535.337

2950. STRUCTURE AND ZEEMAN EFFECT IN THE SPECTRUM OF THE IRIDIUM ATOM, Ir I. T.A.M.van Kleef.
Physica, Vol. 23, No. 9, 843-97 (Sept., 1957).

The analysis of existing wavelength data of the Ir I spectrum has resulted in the detection of one even ground level and 20 odd levels in addition to those reported by previous investigators. Moreover a group of 12 high even levels has been discovered. The total number of classified lines is now 2110, corresponding to 2192 transitions between 30 even ground levels, 164 odd levels and 41 high even levels. The Zeeman effect was investigated in the wavelength region 2300-6000 A. For 905 lines the splitting was observed; of these 296 show resolved patterns. Accordingly, the g-values of practically all levels could be determined and used in the quantum interpretation of the spectrum. The low even terms belong to the electron configurations $5d^76s^2$, $5d^86s$ and $5d^9$; the odd levels could be associated with the configurations $5d^76s6p$, $5d^86p$ and $5d^96s^26p$; the high even levels are assigned to the configurations $5d^76s7s$, $5d^76s6d$ and $5d^96s^27s$. By means of these identifications an ionization potential of (9.1 ± 0.1) V was derived. A.

535.331 : 535.343

2951. EMISSION AND ABSORPTION SPECTRA OF PLUTONIUM EXCITED IN A KING FURNACE. L.Bovey.
Spectrochimica Acta, Vol. 10, No. 4, 383-94 (1958).

A list is given of wavelengths of plutonium absorption and emission lines excited in a King-type furnace and photographed in the second order of a 3 m grating instrument over the region 2791-6888 A. The problems connected with measurement of such lines are briefly discussed and tentative conclusions reached from an attempt to find the energy levels are given. L.Bovey

535.332

2952. CONTINUOUS EMISSION SPECTRA OF RARE GASES IN THE VACUUM ULTRAVIOLET REGION. II. NEON AND HELIUM.
Y.Tanaka, A.S.Jursa and F.J.LeBlanc.
J. Opt. Soc. Amer., Vol. 48, No. 5, 304-8 (May, 1958).

For previous work see Abstr. 8596 (1955). The experimental conditions for, and the characteristics and origin of the recently found Ne continuum are described. The 600 A band and the continuum of helium were reinvestigated in relation to the diffuse bands and continua of the other rare gases. It is suggested that both probably originate from the transition $A^1\Sigma_u^+ - X^1\Sigma_g^+$ of He_2, because of the similarity of their characteristics to those of the resonance lines and continua of the other rare gases, Ne included. A.

535.332

2953. THE INFLUENCES OF ARGON AND NEON ON THE 2536.52 A LINE OF MERCURY.
A.Michels, H.de Kluiver and B.Castle.
Physica, Vol. 23, No. 12, 1131-42 (Dec., 1957).

The 2536.52 A ($^1S_0 - {}^3P_1$) line of mercury was studied in absorption in the presence of argon or neon up to pressures of 1000 and 1500 atm, respectively. Investigations of shift, half-width and oscillator strength of the line as a function of the density or pressure of the foreign gas were made. With argon as a disturbing gas, the line shifts to the red and two satellites were observed on the violet side at distances of 86 cm^{-1} and 170 cm^{-1} from the principal maximum. This is in agreement with the results given by Kuhn for pressures below one atmosphere. The oscillator strength was measured at argon density above 40 amagat, and shows an increase with increase of pressure. Up to 250 amagat, two series of spectral measurements, one series at approximately 50°C and the other at approximately 105°C, were compared with respect to line shape and oscillator strength. The results of the comparison indicate no temperature dependence; all differences fell within the estimated experimental error. An analysis of the line shape was attempted. With neon, the line shifts first to the red and then at higher pressures to the violet. With increasing pressure a pronounced shoulder develops at approximately 235 cm^{-1} from the principal maximum on the violet side. Here the oscillator strength decreases with increasing pressure. A.

535.333

2954. NEW OBSERVATIONS ON TRANSIENT COMPLEXES. EXPERIMENTS ON (Na 3s, A ^1S), (Na 3p, A ^1S). R.Aynard.
C.R. Acad. Sci. (Paris), Vol. 245, No. 19, 1608-11 (Nov. 4, 1957).
In French.

Spectroscopic observations at low pressures are reported and discussed. See Abstr. 6986 (1957). R.F.Barrow

535.333

2955. EMISSION SPECTRUM OF BROMINE EXCITED IN THE PRESENCE OF ARGON. III. THE BAND SYSTEM IN THE REGION 2660-2590 A. R.D.Verma.
Proc. Indian Acad. Sci. A, Vol. 47, No. 3, 196-200 (March, 1958).

For Pt II see Abstr. 953 (1958). The wavelengths and wavenumbers of the band heads of the system 2660-2590 A as obtained from the plates taken on the first-order 21 feet grating spectrograph are given along with its vibrational analysis. This system is shown as the transition from an upper state at $T_e = 56776$ cm^{-1} with $\omega_e = 108.0$ cm^{-1} to the $^3\Pi_u(O_u^+)$ state at $T_e = 15918$ cm^{-1}. The lower state is the same as that of the two systems in the regions 2950-2670 A and 3150-2970 A reported earlier (see Abstr. 952-3/1958). A.

535.337

2956. THE ZEEMAN EFFECT IN THE SPECTRA OF POLYATOMIC MOLECULES. A.E.Douglas.
Canad. J. Phys., Vol. 36, No. 1, 147-9 (Jan., 1958).

The spectra of a number of polyatomic molecules were photographed with a 10 m grating spectrograph in the presence of a magnetic field of from 40 000 to 15 000 Oe. The Zeeman effect was observed only in SO_2 and CS_2. Since the effect is expected to arise from a magnetic moment due to electron spin, this requires the assumption of triplet rather than singlet state for the upper states of the 3600 A band of CS_2 and the 3800 A band of SO_2.
R.C.Seymour

535.338.334 : 539.14

2957. A CONTRIBUTION TO THE THEORY OF THE EXCHANGE NARROWING OF SPECTRAL LINES. R.A.Sack.
Molecular Phys., Vol. 1, No. 2, 163-7 (April, 1958).

The intensity distribution of a composite spectral line with exchange narrowing is calculated by integrating a matrix expression derived by Anderson (Abstr. 9069/1954); the result, which is equally valid for classical and for quantum mechanical models, involves the inversion of a matrix with complex elements. The method is applied to symmetrical doublet and triplet lines and to lines of arbitrary multiplicity when all the transition probabilities are equal. A.

535.343

2958. ELECTRONIC SPECTRA OF MONO-, DI- AND TRI-AZINES OF THE NAPHTHALENE SERIES.
F.Favini, S.Carrà, V.Pierpaoli, S.Polezzo and M.Simonetta.
Nuovo Cimento, Vol. 8, No. 1, 60-7 (April 1, 1958).

The electronic absorption spectra of quinoline, isoquinoline, quinoxaline, phthalazine, quinazoline and cinnoline were obtained. The bands are assigned to the different electronic transitions, and for the $\pi-\pi^*$ transitions the experimental results for position and intensity are compared with values from theoretical calculation, to which they closely agree. A.

535.343

2959. ELECTRONIC SPECTRUM OF MONOMERIC NITROGEN DIOXIDE AT LIQUID HELIUM TEMPERATURE.
G.W.Robinson, M.McCarty,Jr and M.C.Keelty.
J. chem. Phys., Vol. 27, No. 4, 972-3 (Oct., 1957).

NO_2 monomer may be trapped at 20°K in a matrix of 400 parts N_2 to 1 of NO_2, and its spectrum in the region 3400-7000 A photographed at 4.2 and 1.5°K on a 0.75 metre grating spectrograph. N_2O_4 bands were absent. R.C.Seymour

535.343 : 539.373

2960. EFFECT OF DEFORMATION ON THE SPECTRUM OF CdS CRYSTALS. E.F.Gross and B.S.Razbirin.
Zh. tech. Fiz., Vol. 28, No. 2, 237-9 (1958). In Russian.

Deals with variations of the narrow lines on the long-wavelength side of the intrinsic absorption edge. They are shown to be related to elastic deformation of crystals, which were stuck to glass or quartz plates, on cooling to liquid-helium temperature.

535.343

2961. INFRARED EMISSIVITIES AND ABSORPTIVITIES OF GASES. S.S.Penner and A.Thomson.
J. appl. Phys., Vol. 28, No. 5, 614-23 (May, 1957).

Approximate analytic expressions are obtained for the "effective band widths" and emissivities of diatomic molecules at elevated pressures. The absorptivities of molecular vibration-rotation bands are evaluated for radiation emitted by similar molecular vibration-rotation bands and for radiation emitted by black bodies. The results obtained for the absorptivity calculations compare favourably with available empirical correlations for H_2O. The postulated model does not apply to CO_2 and, therefore, no satisfactory theoretical formula was derived for the absorptivities of this molecule. A critical examination is also given of the limits of validity of the effective bandwidth concept for different molecules. A.

535.343

2962. THE PRESSURE-INDUCED ROTATIONAL ABSORPTION SPECTRUM OF HYDROGEN. I. J.P.Colpa and J.A.A.Ketelaar.
Molecular Phys., Vol. 1, No. 1, 14-22 (Jan., 1958).

The pressure-induced rotational absorption spectrum of hydrogen was investigated at −60°C, 25°C and 80°C in pure hydrogen and in mixtures of hydrogen with helium, argon, nitrogen and carbon monoxide. The integrated absorption coefficients are evaluated. In mixtures of hydrogen and carbon monoxide a simultaneous rotational-vibrational transition could be observed. A.

535.343

2963. INFRARED SPECTRUM OF NT_4Cl.
H.W.Morgan, P.A.Staats and J.H.Goldstein.
J. chem. Phys., Vol. 27, No. 5, 1212 (Nov., 1957).

The i.r. spectrum of NT_4^+ was observed in NT_4Cl produced by slow reaction of ionized NT_3 with the AgCl windows of the absorption cell. R.C.Seymour

535.343

2964. INFRARED SPECTRA OF $N^{15}H_3$ AND $N^{15}H_4^+$.
H.W.Morgan, P.A.Staats and J.H.Goldstein.
J. chem. Phys., Vol. 27, No. 5, 1212-13 (Nov., 1957).

Vibrational frequencies (to within ±2 cm^{-1}) of $N^{15}H_3$ (10 cm path at 200 mm Hg pressure) and of $N^{15}H_4^+$ (solid film of NH_4Cl at 22° and −190°C) were observed and the isotope shifts measured (to ±1 cm^{-1}). R.C.Seymour

535.343

2965. INTEGRATED ABSORPTION BY THE 9.6 μ BAND OF OZONE. C.D.Walshaw.
Quart. J. Roy. Meteorol. Soc., Vol. 83, 315-21 (July, 1957).

An account is given of laboratory measurements using dry air as the foreign gas. The experimental results for the band area, A_r, are tabulated for ozone amounts up to 1.5 cm S.T.P. and for pressures from 10 to 760 mm Hg, at a temperature of 20°C; the slit width is 6.5 cm^{-1}. An empirical formula for A_r is given. The best fit is obtained with slightly modified values of the u.v. absorption coefficients determined by Vigroux (Abstr. 2300/1954), when the standard error in band area is 2.4%. A.

535.343

2966. INFRARED DISPERSION IN THE NEIGHBOURHOOD OF THE R(2) LINES OF THE FIRST HARMONIC BAND OF HYDROCHLORIC ACID. F.Legay.
Rev. Opt., Vol. 37, No. 1, 11-17 (Jan., 1958). In French.

A Michelson interferometer was used in conjunction with a grating spectrometer. Theoretical curves are deduced for the dependence of $\nu_0 - \nu$ on the width of the spectrometer slit, and experimental results for three slit-widths are presented. G.I.W.Llewelyn

535.343 : 535.375.5

2967. INFRARED AND RAMAN SPECTRA OF BORON OXIDE. II. INFRARED SPECTRA AND MOLECULAR STRUCTURE.
T.A.Sidorov and N.N.Sobolev.
Optika i Spektrosk., Vol. 3, No. 6, 560-7 (1957). In Russian.

The infrared spectra of sublimed layers of both natural and enriched (71% of B^{10}) boron oxide were measured between 2.5 and 24 microns. A table of frequencies is given together with the absorption curves; the change with time of part of the spectrum when a layer is exposed to air is shown. From a discussion of the active infrared and Raman transitions it is concluded that the molecular formula is B_4O_6 and the group symmetry T_d. L.Bovey

535.343 : 535.375.5

2968. INFRARED AND RAMAN SPECTRA OF BORON OXIDE. III. INTERPRETATION OF THE VIBRATIONAL SPECTRUM AND CALCULATION OF THE ISOTOPIC EFFECT.
T.A.Sidorov and N.N.Sobolev.
Optika i Spektrosk., Vol. 4, No. 1, 9-16 (1958). In Russian.

Force constants were determined on the assumption that boron oxide molecule has T_d group symmetry and frequencies 1035, 808, and 470 cm^{-1} belong to symmetry types A_1, A_1 and E, respectively. The infrared and Raman spectra are assigned and isotope shifts calculated for some of the fundamentals. L.Bovey

535.343 : 537.311.33

INFRARED ABSORPTION OF OXYGEN IN SILICON. See Abstr. 2326

535.343 : 539.19

MICROWAVE SPECTRUM OF ACETIC ACID. See Abstr. 2605

535.343 : 539.19

MICROWAVE SPECTRUM OF TRANS-FLUORO-PROPYLENE. See Abstr. 2607

535.345 : 535.371

2969. PROPERTIES OF COPPER DOPED ROCKSALT SINGLE CRYSTALS. E.Boesman and W.Dekeyser.
Physica, Vol. 24, No. 1, 52-8 (Jan., 1958).

A study of rocksalt activated with an element, which could be present as mono- or divalent ion (copper) was undertaken. Absorption data, showing peaks and long wavelength tail due to Cu^+ and Cu^{++}, and influence of quenching and annealing on the absorption curve curve are given. Emission spectra of the luminescence, with and without stimulation by X-ray irradiation, both at room temperature and liquid air temperature, and the influence of heating were also studied. Evidence is presented for the formation of small aggregates at low temperatures, their relation with luminescence, and for the dependence of the luminescent properties on treatment with gases. A.

535.37 : 535.375.5 : 535.43

2970. CLASSIFICATION OF SECONDARY EMISSION OF LIGHT. B.I.Stepanov and P.A.Apanasevich.
Dokl. Akad. Nauk SSSR, Vol. 116, No. 5, 772-5 (1957). In Russian.

Transformed light is usually classified into photoluminescence, the Rayleigh and the Raman (combination) scattering. According to Vavilov, luminescence is an emission whose duration exceeds the period of the vibrations of the light and which, consequently, can be quenched. On the other hand, scattering disappears (or arises) practically at the same moment when the action of the constraining force stops (or starts), and it is assumed that scattering cannot be quenched. The author develops the theoretical foundation of Vavilov's criterion and obtains equations for three lines corresponding with the three main types of transformed light. F.Lachman

535.37

2971. DETERMINATION OF THE NATURE OF AN ELEMENTARY EMITTER WHEN THE DIRECTIONS OF THE ABSORPTION AND EMISSION OSCILLATORS DO NOT COINCIDE.
A.N.Sevchenko and G.P.Gurinovich.
Dokl. Akad. Nauk SSSR , Vol. 117, No. 5, 798-801 (1957). In Russian.

A method developed by Vavilov (Zh. éksper. teor. Fiz., Vol. 10, 1363, 1940) and Feofilov (Dokl. Akad. Nauk SSSR, Vol. 55, 407, 1947) from investigations on polarized luminescence, at different angles to the direction of the exciting light, is further developed for the case when the angle between the oscillators is $\alpha \neq 0$, and for different combinations of electric dipoles and quadrupoles, magnetic dipoles, and electric and magnetic dipoles. The obtained eight formulae can be easily used in graphic form. F.Lachman

535.37

2972. THE POLARIZATION OF LUMINESCENCE IN DIAMOND.
R.J.Elliott, I.G.Matthews and E.W.J.Mitchell.
Phil. Mag. (Eighth Ser.), Vol. 3, 360-9 (April, 1958).

It is shown that the polarization of luminescence from a cubic crystal, when excited by plane-polarized light, may be used to determine the symmetry axes of the luminescent centres. This information is most readily obtained from a specimen which is bounded by (100) faces and by using light travelling normally to the faces. Experiments on a diamond cut in this way are described. The results are given for the green luminescence from centres induced by heat treatment after irradiation. These centres appear to have symmetry axes along ⟨110⟩ directions. A.

535.37

2973. INFLUENCE OF FLUX ON THE LUMINESCENT PROPERTIES OF Cu-ACTIVATED CaS PHOSPHORS.
S.Asano and T.Kishimoto.
Sci. of Light (Tokyo), Vol. 6, No. 3, 101-7 (Dec., 1957).

The influence of addition of flux on the luminescent properties and ultraviolet absorption of Cu-activated CaS phosphors is investigated. As flux, sulphates, fluorides and chlorides of Li, Na and K are used. Cu-activated CaS phosphors show, in general, two emission bands at about 430 mμ and 495 mμ and the sulphate and fluoride fluxes intensify the latter band, whereas chloride fluxes the former. In addition, it may be inferred that the latter band originates from CaS host crystal itself and the former from Cu-activator located in it. A.

535.371

2974. ON THE THEORY OF POLARIZATION OF THE FLUORESCENCE OF SOLUTIONS. P.I.Kudryashov and B.Ya.Sveshnikov.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 5, 894-7 (1957). In Russian.

Levshin's (1924-5) and Perrin's (1929) formula $1/p-1/p_0 = (1/p_0-1/3)(kT/v\eta)\tau$, where η is the viscosity of the solution, v-molecular volume, τ-duration of excitation, p-polarization sought, and p_0-polarization at $\eta \to \infty$ and $\tau \to 0$, is known to give poor results when fluorometric τ-values are used, but it yields good results when $(B/B_0)\,\tau_0$ is substituted for τ (B and B_0 are fluorescence yields in the quenched and the non-quenched solution, respectively). The authors develop a more general formula based on the theoretical and experimental evidence that decay in quenched solutions follows a non-exponential law. Values calculated for p_0 from experimental values of p and η for fluorescein in water–glycol and water–glycerol mixtures were consistent, and agreed well with p_0 values calculated for KI solutions using the new formula, whereas the previous formula, even with $\tau = (B/B_0)\tau_0$, gave considerably lower results. F.Lachman

535.371

2975. FLUORESCENCE INVESTIGATION ON CADMIUM VAPOUR AND A CADMIUM-CAESIUM VAPOUR MIXTURE.
H.Friedrich and R.Seiwert.
Exper. Tech. der Phys., Vol. 5, No. 5, 193-205 (1957). In German.

535.371

2976. DELAYED FLUORESCENCE OF COMPLEX MOLECULES IN THE VAPOR PHASE. R.Williams.
J. chem. Phys., Vol. 28, No. 4, 577-81 (April, 1958).

It was found that the vapours of several fluorescent aromatic hydrocarbons have two components in their fluorescence. These

have the same emission spectrum but greatly differing decay times. The lifetime of the fast component is probably that which would be predicted from the strength of the absorption spectrum. This investigation was concerned with the slow component whose decay was exponential with a lifetime of the order of milliseconds. Detailed observation of the behaviour of this lifetime as several experimental conditions were changed has shown that a bimolecular process is responsible for the delayed emission. A mechanism is proposed and discussed in detail. A.

535.371 : 621.327.534.15

2977. CERIUM-ACTIVATED HALOPHOSPHATE PHOSPHORS.
S.T.Henderson and P.W.Ranby.
J. Electrochem. Soc., Vol. 104, No. 10, 612-15 (Oct., 1957).

The characteristics are given of a new group of alkaline earth halophosphate phosphors activated by Ce and Mn, and their behaviour is compared with that of halophosphates containing other primary activators. In their preparation these cerium-activated materials show marked differences from other previously known halophosphates, but the luminescent properties are similar to those of the tin-activated system. The behaviour and possible uses of these phosphors in fluorescent lamps are described. A.

535.371

2978. THE CALCIUM–SILICATE–TUNGSTATE PHOSPHOR; PHASE RELATIONSHIPS AND FLUORESCENT PROPERTIES.
D.E.Harrison and F.A.Hummel.
J. Electrochem. Soc., Vol. 105, No. 1, 34-7 (Jan., 1958).

An efficient phosphor can be prepared by a co-crystallization of β-$CaSiO_3$:Mn + Pb and $CaWO_4$:Pb. The fluorescence, excited by either 2537 A or cathode radiation, is that of a mechanical mixture of β-$CaSiO_3$:Mn + Pb and $CaWO_4$:Pb. In the presence of tungstic oxide, the formation of β-$CaSiO_3$ is greatly accelerated. Determination of the pertinent compatibility tetrahedra in the system $CaO–MnO–SiO_2–WO_3$ revealed that the phosphor compositions lie in the subtetrahedron β-$CaSiO_3$–$MnSiO_3$–SiO_2–$CaWO_4$. X-ray data showed that there was no solid solubility of $\beta(Ca_{1-x}Mn_x)SiO_3$ in $CaWO_4$; the fluorescence of $CaWO_4$ is adversely affected by MnO. A.

535.371

2979. THE LUMINESCENCE OF SELF-COACTIVATED ZnS:Cu.
M.H.Aven and R.M.Potter.
J. Electrochem. Soc., Vol. 105, No. 3, 134-40 (March, 1958).

Phosphors prepared by firing ZnS with Cu in purified H_2S show a simple orange emission band, with no other bands in evidence, even at 90°K. Excitation by u.v. radiation, cathode rays, and electric field gives identical emission spectra. The emission-band has peaks at the same wavelength for samples with either hexagonal or cubic crystal structure, but is shifted to longer wavelengths by addition of CdS. The orange luminescence is strongly decreased by traces of H_2O in the H_2S firing atmosphere, but quite stable to firing in oxidizing or reducing atmospheres. Addition of Al to ZnS:Cu gives a series of phosphors showing various proportions of orange, blue, and green emission. Firing ZnS with Ag in pure H_2S gives a new yellow-emitting phosphor with properties very similar to the orange Cu-activated phosphor. Possible models for the orange centre are discussed. A.

535.371

2980. CONCENTRATION QUENCHING IN FLUORESCENT ACENE SOLUTIONS. A.Dammers-de Klerk.
Molecular Phys., Vol. 2, No. 1, 141-50 (April, 1958).

Measurements on the concentration dependence of the fluorescence intensity of dilute solutions of various acenes in n-hexane at 25° C show that the concentration quenching for benzene as a solute can be explained by simple collisional quenching. In solutions of naphthalene and anthracene the concentration quenching proceeds via an unstable excited complex resulting from the interaction of an excited and non-excited molecule. The remarkable shape of the concentration curve of naphthalene is attributed to a contribution of the excited naphthalene complex to the total fluorescence intensity. The average lifetime of the fluorescent electronic state, as calculated from the measurements, amounts to about 2×10^{-8} sec for benzene and 5×10^{-7} sec for naphthalene. A.

535.371

2981. OSCILLATOR STRENGTHS FOR LUMINESCENT TRANSITIONS IN KCl:Tl AND KCl:In.
F.E.Williams, B.Segall and P.D.Johnson.
Phys. Rev., Vol. 108, No. 1, 46-9 (Oct. 1, 1957).

Oscillator-strength ratios for the two principal impurity absorption bands of KCl:Tl and KCl:In are calculated including the effect of crystalline interactions. The phosphor KCl:In was devised in order to provide an additional check of the theoretical analysis. The excited impurity states are assumed to be of the nature of $^1P^0$ and $^3P^0$ states of the sp configuration mixed by spin–orbit interaction. Spin–orbit coupling constants are obtained from free-ion spectra. Crystal interactions are included by using experimental transition energies for the crystal to calculate the energy separation of the pure singlet and triplet states in the crystal. The calculated oscillator-strength ratios are in satisfactory agreement with experiment. A.

535.371

2982. THE FLUORESCENCE OF DIAMOND.
H.B.Dyer and I.G.Matthews.
Proc. Roy. Soc. A , Vol. 243, 320-35 (Jan. 14, 1958).

The fluorescence has been recorded both photographically and photoelectrically, and the apparatus developed for each of these methods is described. The 3650 A group of mercury lines has been found to excite fluorescence in all the type I and IIa diamonds examined, but type IIb specimens have given no emission with this wavelength. The fluorescence spectra usually contain one or more "systems" of lines, each system consisting of a main principal line accompanied by a banded ancillary structure. These systems are described and compared with features found in absorption spectra. Excitation spectra have been obtained for the two common fluorescence systems and are compared with absorption spectra. The effect of irradiation and of subsequent heat treatment on the fluorescence spectrum is described. Finally, the results are used to draw some conclusions about the nature of the centres responsible for the fluorescence. A.

535.371.07 : 621.385.832

2983. INFLUENCE OF BINDERS UPON SURFACE BRIGHTNESS OF CATHODE-RAY TUBE SCREENS. I.Hangos.
Acta tech. Hungar., Vol. 19, No. 1-2, 67-84 (1957).

Of the factors causing reduction in screen brightness, the chief is considered to be the reduction of electron energy by the bonding layers. A demountable cathode-ray tube is described for experiments on small experimental screens settled in potassium silicate. Measurements of brightness are given for different voltages and for three coagulants that show varied results: strontium nitrate, sodium sulphate and ethyl alcohol. S.T.Henderson

535.372

2984. RELATIONSHIP BETWEEN THE EFFICIENCY OF SOME QUENCHERS OF FLUORESCENCE AND THE POSITION OF THE FLUORESCENCE SPECTRUM.
V.V.Zelinskiĭ, V.P.Kolobkov and N.I.Kondaraki.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 3, 391-4 (1957). In Russian.

Presents in tables and graphs the results of experiments on the relationship between the effect of impurities (aniline, triethylamine iodide and KI) on the duration of the excitation state of four phthalimide derivatives in different solvents, and the spectral position of fluorescence bands. The relationship was found to apply to in all cases, except with KI in water, the latter probably because of the greater electrolytic dissociation of KI in water. (See Abstr. 4220/1957). F.Lachman

535.372

2985. STUDIES ON SOME INFRARED STIMULABLE PHOSPHORS.
S.P.Keller, J.E.Mapes and G.Cheroff.
Phys. Rev., Vol. 108, No. 3, 663-76 (Nov. 1, 1957).

The physical properties of the two phosphor systems SrS:Ce, Sm, and SrS:Eu, Sm, as well as the base material SrS, were studied. The optical studies concern spectra of transmission, excitation, fluorescence, phosphorescence, stimulation, and stimulated emission. Relative storage efficiencies of the major exciting wavelengths were measured. Time characteristics of the phosphorescence and the i.r. exhaustion were determined. The d.c. photoconductive response as a function of the wavelength of the incident light was studied. A simplified band-theory model is presented, which correlates all of the experimental data in conjunction with the electronic structures of the activators. A.

535.376 : 621.385.832

2986. BILAYER BICHROMATIC CATHODE SCREEN. C.Feldman.
J. Opt. Soc. Amer., Vol. 47, No. 9, 790-4 (Sept., 1957).

Screens consisting of superimposed, thin, transparent, luminescent layers were formed by evaporation in a vacuum. The colour of the luminescent emission depends on the depth of penetration of the cathode-rays into the bilayer screens. Due to the decrease in luminescent brightness after the phosphor layers are penetrated,

the pure chromatic emission from both of the layers may be obtained. A particular screen consisting of Al/$CaWO_4$[W] (blue)/ZnS[Mn] (yellow)/glass was analysed. The laws of colour mixture are found to be obeyed. Optical interference effects in the screen produce a slight colour shift in the emission. The basic ideas of the multilayer chromatic system are briefly discussed. A.

535.376

2987. ELECTROLUMINESCENCE. S.T.Henderson.
Brit. J. appl. Phys., Vol. 9, No. 2, 45-51 (Feb., 1958).

An account is given of the present state of field-controlled luminescence, with references to the earlier experiments using additional forms of excitation, and to carrier injection luminescence. Intrinsic electroluminescence is dealt with at greater length, the main aspects considered being the phosphor, the voltage against brightness relation, and emission waveforms. Theoretical discussions of the process and practical applications are reviewed. A.

535.376

2988. ELECTROLUMINESCENCE OF ZINC SULFOSELENIDE PHOSPHORS WITH COPPER ACTIVATOR AND HALIDE COACTIVATORS. I.J.Hegyi, S.Larach and R.E.Shrader.
J. Electrochem. Soc., Vol. 104, No. 12, 717-21 (Dec., 1957).

The choice of halide coactivators in the synthesis of electroluminescent powder phosphors of the Zn(S:Se):Cu system markedly affects the spectral distribution and efficiency of the phosphors. Iodide coactivated ZnS:Cu can be prepared as a blue-emitting phosphor exhibiting no shift in spectral emission with field excitation from 20 to 50 000 c/s. Several-fold increase in radiant output over the chloride coactivated ZnS:Cu phosphor is obtained by using iodide coactivator. ZnSe:Cu phosphors, iodide coactivated, also show no shift in spectral distribution with frequency. However, the emission from Zn(S:Se):Cu materials, prepared with any of the halide coactivators, shifts to lower peak wavelength with increasing frequency of excitation. A red-emitting electromuminescent phosphor can be synthesized from the (Zn:Cd):Se:Cu system by the use of bromide or iodide as a coactivator. The role of the halide is extended from that of a randomly distributed donor to one of association with the activator, and consequences of such activator-coactivator association are discussed. A.

535.376 : 537. 312.5 : 621.383.4

2989. SOLID STATE IMAGE AMPLIFIERS. G.F.J.Garlick.
J. sci. Instrum., Vol. 34, No. 12, 473-9 (Dec., 1957).

Recent developments in solid-state image devices using photoconductors and electroluminescent phosphors are described. The simplest device uses a thin homogeneous phosphor layer between transparent electrodes, while more complex amplifiers use a combination of photoconductor and phosphor layers. By using alternating applied fields, microcrystalline photoconductors and phosphors dispersed in dielectric films may be used. The solid-state amplifier offers possibilities for image conversion in the i.r. up to 6 μ, in the u.v. and in the X-ray regions. A.

535.377

2990. SOME OBSERVATIONS OF THE EFFECT OF AGEING IN SULPHIDE PHOSPHORS. A.Wrzesińska.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 5, No. 12, 1137-40 (1957).

The thermoluminescence intensity of an alkaline earth sulphide phosphor deteriorates when it is heated in a moist atmosphere. Similar decreases in luminosity are observed for the several peaks in the glow curve associated with different traps, suggesting that the ageing is due to chemical changes in the luminescent centres. Partial regeneration occurs after resting for 15 hr. J.B.Birks

535.377 : 539.2

2991. THERMOLUMINESCENCE AND COLORATION OF LITHIUM FLUORIDE PRODUCED BY ALPHA PARTICLES, ELECTRONS, GAMMA RAYS, AND NEUTRONS.
F.F.Morehead and F.Daniels.
J. chem. Phys., Vol. 27, No. 6, 1318-24 (Dec., 1957).

The coloration and thermoluminescence produced in LiF by 2 MeV alpha-particles, by 2 MeV electrons, by 1 MeV gamma-rays from Co^{60}, and by thermal neutrons are described. The energy initially required to produce an F-centre varies. It is about 700 eV for alpha, 140 eV for beta, 65 eV for gamma rays, and 65 eV for thermal neutrons. The amount of thermoluminescence light produced and the number of thermoluminescence peaks increased with the exposure to each of these radiations. The larger the radiation dosage, the greater is the fraction of thermoluminescence emitted at the higher temperatures. All of the thermoluminescence is related to the emptying of F-centres, but only one photon is emitted as visible thermoluminescence for every 10^4 electrons removed from F-centres. The optical and thermal decolorizations are discussed. A.

535.377

2992. THERMOLUMINESCENCE OF FOURTEEN ALKALI HALIDE CRYSTALS. I.F.Heckelsberg and F.Daniels.
J. phys. Chem., Vol. 61, No. 4, 414-18 (April, 1957).

In this investigation the thermoluminescence glow curves of fourteen alkali halides from liquid air temperature to red heat were measured after exposure of the crystals to X-ray or γ-radiation. The effects produced by various amounts of radiation were studied using crystals of LiF and NaCl. The thermoluminescence of mixed crystals containing various alkali halides was also studied. A.

535.378 : 537.311.33

2993. TRIBOLUMINESCENCE IN SEMICONDUCTORS.
D.A.Jenny.
J. appl. Phys., Vol. 28, No. 12, 1515 (Dec., 1957).

Sand blasting of semiconductors (Ge, Si, InP, GaAs and diamond) with Al_2O_3, SiC or SiO_2 abrasive powders in a gas stream (H_2, O_2, He, A or CO_2) produced emission independent of the p or n state of the semiconductor, of purity and of crystallinity, but showed a relation to the lattice absorption edge.

G.F.J.Garlick

535.39 : 539.234

2994. THE REFLECTING POWER AT NORMAL INCIDENCE FROM THE VISIBLE TO THE FAR ULTRAVIOLET OF DEPOSITS OF GERMANIUM OBTAINED BY EVAPORATION IN VACUO.
S.Kandare.
C.R. Acad. Sci. (Paris), Vol. 245, No. 20, 1716-18 (Nov. 13, 1957).
In French.

A curve is given for the wavelength range 1100 to 5000 A. As with Se and Te (Abstr. 8533/1957) the reflecting power varied with evaporation conditions. It was highest for rapid evaporation from a Ta boat. B.T.M.Willis

535.39 : 539.234

2995. OPTICAL PROPERTIES AND STRUCTURE OF CERIUM DIOXIDE FILMS. G.Hass, J.B.Ramsey and R.Thun.
J. Opt. Soc. Amer., Vol. 48, No. 5, 324-7 (May, 1958).

The refractive index and the absorption coefficient of evaporated CeO_2 films were measured in the wavelength region from 0.22 μ to 1.0 μ. Films produced by direct evaporation of CeO_2 were found to be extremely durable and nonabsorbing in the visible and can be used as beam splitters and as high-index films in multilayer film combinations. The refractive index of CeO_2 films depends strongly on the temperature of the substrate. An increase of the substrate temperature from 25°C to 300°C increases the refractive index of the condensed film material at λ = 550 mμ, from about 2.2 to 2.4. The absorption of CeO_2 films increases strongly below 400 mμ and reaches a maximum at 300 mμ. Evaporated CeO_2 films show the same cubic structure as compact material and crystallize without preferred orientation on amorphous substrates. The crystal size in the condensed films increases with increasing temperature. A.

535.392

2996. ANTI-REFLEXION COATINGS FOR INDIUM ANTIMONIDE AND OTHER SEMI-CONDUCTOR FILTERS. S.D.Smith and T.S.Moss.
J. sci. Instrum., Vol. 35, No. 3, 105-6 (March, 1958).

Several important infra-red filters use semiconductors with refractive indices near 4 (e.g. Ge, PbS InSb), which have high reflection losses. Lead chloride is shown to be a good material for "blooming" these semiconductors. Such "blooming" more than doubles the transmission of an InSb filter from 10 to 13.5μ. A.

535.393 : 539.23

2997. ON THE OPTICAL CONSTANTS OF THIN LAYERS OF SILVER. F.Grard.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 43, No. 9, 628-40 (1957).
In French.

An analysis is given of the optical constants of thin films of Ag of thickness from 6.5 to 722 A, as measured in the wavelength range 3000 to 5800 A. The resonance frequency 22 300 cm^{-1}, which is characteristic of the bulk metal, has progressively less influence on the optical properties as the film thickness falls.

B.T.M.Willis

535.393 : 539.23

2998. ON THE OPTICAL CONSTANTS OF THIN LAYERS OF PALLADIUM. F.Grard.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 43, No. 9, 641-6 (1957). In French.

The optical constants of thin layers of Pd of thickness from 50.5 to 303 A indicate no resonance frequencies between 18 300 and 33 100 cm^{-1}. B.T.M.Willis

535.393 : 539.23

2999. OPTICAL PROPERTIES OF Al FOR hν BETWEEN 10 AND 26 eV. W.C.Walker, J.A.R.Samson and O.P.Rustgi.
J. Opt. Soc. Amer., Vol. 48, No. 1, 71 (Jan., 1958).

Curves are given for the transmissivity and reflectivity of evaporated Al films, 1000 A thick. The transmissivity increases rapidly from 15 to 23 eV and the reflectivity decreases rapidly above 14 eV. The results agree with Pines' theory, which shows that at the free electron plasmon energy ($h\nu \cong 15$ eV) Al changes from an opaque to a moderately transmitting medium.

B.T.M.Willis

535.415 : 535.66 : 518.5

3000. A METHOD OF CALCULATING INTERFERENCE COLOR OF THIN FILMS USING AN AUTOMATIC RELAY COMPUTER. K.Miyake.
Sci. of Light (Tokyo), Vol. 6, No. 3, 77-84 (Dec., 1957).

Using an automatic relay computer, a method for determining the interference colour of thin films is studied. Calculation of chromaticity of the interference colour is performed more conveniently by the summation of integrand at equal intervals of wave-number than at equal intervals of wavelength, if the change of refractive index with wavelength is neglected. The C.I.E. colorimetric data of $E_\lambda\bar{x}_\lambda$, $E_\lambda\bar{y}_\lambda$, $E_\lambda\bar{z}_\lambda$ are transformed into a table using the wave-number in 200 cm^{-1} intervals as variable and are given in the range extending from 13 000 cm^{-1} to 27 000 cm^{-1}. A.

535.417 : 532.72

3001. A NEW INTERFEROMETRIC METHOD FOR THE DETERMINATION OF DIFFUSION COEFFICIENTS OF VERY DILUTE SOLUTIONS. O.Bryngdahl.
Acta chem. Scand., Vol. 11, No. 6, 1017-33 (1957).

A new simple and rapid interferometric method is described for studying diffusion and other phenomena giving rise to a refractive index gradient in a solution. The method utilizes birefringence interferences and is found to possess a high degree of precision which probably cannot be attained by methods where the optical power of resolution sets a serious limit to the amount of accuracy attainable. In addition the method is particularly valuable in the study of cases where the refractive index gradient has a low value. By virtue of this fact, measurements can be extended to very low concentration differences. The possibility of arranging differential diffusion experiments with very low concentration gradients also provides a convenient means of studying the concentration dependence of the diffusion coefficient. The new method should further offer a possibility of verifying the Fuoss and Onsager theory for the diffusion coefficients of very dilute electrolytic solutions. A.

535.417 : 535.345.6

3002. A TUNABLE INFRA-RED INTERFERENCE FILTER. S.D.Smith and O.S.Heavens.
J. sci. Instrum., Vol. 34, No. 12, 492-6 (Dec., 1957).

An i.r. Fabry–Perot interferometer working at very low orders as a tunable narrow-band interference filter is described. The high-reflecting surfaces are provided by Ge/cryolite quarter-wave stacks, and the air gap between the surfaces may be varied to change the wavelength passed by the filter. It is shown that the luminosity of such an interference monochromator may be several hundred times higher than that of a prism of grating instrument of comparable size. A.

535.42

3003. THE DIFFRACTION WAVE IN KIRCHHOFF DIFFRACTION THEORY. [Die Beugungswelle in der Kirchhoffschen Theorie der Beugung.] A.Rubínowícz.
Warsaw: Panstwowe Wydawnictwo Naukowe (1957) 305 pp. [Polnische Akademie der Wissenschaften. Physikalische Monographien.] In German.

A monograph on the application of the edge- or boundary-wave principle in diffraction theory, mainly theoretical and mathematical; no numerical results. I. Huygens' principle: Fresnel diffraction, the Sommerfeld radiation condition, propagation of discontinuities. II. Physical basis of Kirchhoff theory: multipole sources, Babinet's principle. III. The boundary wave: splitting Kirchhoff integral into direct and diffracted waves, Maggi's formula, structure of the boundary wave, propagation through a focus. IV. Diffraction at a half-plane: the Kirchhoff solution, the Sommerfeld solution for scalar waves, effects near the edge of the shadow. V. Approximations: geometrical optics, effects at large distances from and near to the edge of the shadow, Fraunhofer diffraction. VI. Electromagnetic waves and electron waves. VII. Propagation of diffracted waves in the reverse direction. There are over 200 references, in some cases going back to original sources over 100 years. W.Weinstein

535.42 : 534.321.9

3004. THE DIFFRACTION OF LIGHT BY TWO PERPENDICULAR ULTRASONIC WAVES. II. P.Phariseau.
Physica, Vol. 23, No. 12, 1103-14 (Dec., 1957).

Solutions in the form of a series of Bessel functions are deduced for the systems of difference-differential equations of Pt I (Abstr. 8541/1957). After giving rigorous relations between the coefficients explicit expressions are given for the intensities of the different spectra in the case of small widths of the ultrasonic field. Investigating the extremum of these intensities for variable angles of incidence, it is found that they become maximum when the angle of incidence is equal to the Bragg angle. The complete analogy is thus proved between the diffraction of light by two perpendicular supersonic waves and the X-ray diffraction in crystals. A.

535.421 : 534.152

LIGHT-BEAM MODULATOR USING DIFFRACTION GRATINGS. See Abstr. 2884

535.43 : 536.424

3005. ON THE THEORY OF SCATTERING OF LIGHT NEAR POINTS OF PHASE TRANSITIONS OF THE SECOND KIND. M.A.Krivoglaz and S.A.Rybak.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 139-50 (1957). In Russian.

Scattering of light by ferroelectric or ferromagnetic crystals near phase-transition points of the second kind (order) is considered. The calculations are carried out for single-component crystals, as well as for solid solutions. As examples, scattering of light by $BaTiO_3$, Rochelle salt or KH_2PO_4-type crystals is considered. The effect of an external field on scattering of light is investigated. A.

535.43 : 539.12 : 530.16

SCATTERING OF LIGHT AND KRAMERS–KRONIG DISPERSION RELATIONS. See Abstr. 2812

535.43 : 530.162

RAYLEIGH SCATTERING OF LIGHT. See Abstr. 2821

535.434.07

3006. THE CONSTRUCTION AND TESTING OF A "UNIVERSAL" LIGHT SCATTERING APPARATUS. W.J.Hughes and P.Johnson.
J. sci. Instrum., Vol. 35, No. 5, 157-9 (May, 1958).

The apparatus is suitable for the investigation of macromolecules in solution. By the use of a parallel beam of light through the scattering solution, calibration anomalies were removed, and the apparatus can be calibrated by, or utilized for scattering measurements on, liquids of any refractive index. A.

535.51 : 531.717.1

OPTICAL FILM THICKNESS MEASUREMENT BY PHOTOELECTRIC ELLIPSOMETER. See Abstr. 2827

535.515

3007. RELATIVE STRESS-OPTICAL COEFFICIENTS OF SOME NATIONAL BUREAU OF STANDARDS OPTICAL GLASSES. R.M.Waxler and A.Napolitano.
J. Res. Nat. Bur. Stand., Vol. 59, No. 2, 121-5 (Aug., 1957).

The relative stress-optical coefficients of 27 optical glasses made at the National Bureau of Standards were determined. The glasses were loaded in compression, and the amount of birefringence was measured with a polarimeter, using a quarter-wave plate compensator. The stress-optical coefficients determined for the crown glasses ranged between +2.95 and +1.82 brewsters. For the flint glasses, a regular variation of the stress-optical coefficient with weight percent of lead oxide was found with values ranging from +3.18 to −1.16 brewsters. A.

535.551 : 532.52

3008. OPTICAL METHOD FOR ANALYSIS OF FLUID MOTION. L.E.Hargrove, Jr and G.B.Thurston.
J. Acoust. Soc. Amer., Vol. 29, No. 8, 966-7 (Aug., 1957).

This method of showing fluid motion utilizes the optical interference patterns observed in a flow-birefringent liquid when viewed between crossed polarizing plates. The fluid used is an aqueous solution of milling yellow, a commercial dye product. The

optical interference patterns are related to the stress distribution and streamline directions in the moving fluid. Fluid preparation and photographic techniques are described. Photographs of the patterns obtained are presented for an orifice in a thin plate and for an unbaffled tube. A.

535.563 : 538.614

3009. FARADAY EFFECT IN CUBIC CRYSTALS.
V.Sivaramakrishnan.
J. Indian Inst. Sci. A, Vol. 39, No. 1, 1-7 (Jan., 1957).

The magneto-optical rotation was measured in five cubic crystals (KCl, KBr, KI, LiF and MgO) for a number of wavelengths from 5780 to 2848 A. Dispersion formulae are proposed for both optical refraction and magneto-optical rotation, the formula for the latter fitting the experimental data to within $\frac{1}{2}$%. It is found that in the case of alkali halides all the absorption wavelengths, characteristic of the substances, affect the rotation in the same proportion as they do the refraction, i.e. the value of the anomaly factor for different absorption frequencies is the same. The values of anomaly factor are less than unity (which is the value to be expected of atoms and ions having the inert gas structure), being 0.85, 0.85, 0.87 and 0.84 for KCl, KBr, KI, and LiF respectively. In MgO, the value of the anomaly factor for 1300 A is found to be 0.96, while that for the other wavelength 400 A is zero. A.

535.563 : 538.614

3010. DISPERSION OF FARADAY ROTATION IN SOME OPTICAL GLASSES. V.Sivaramakrishnan.
J. Indian Inst. Sci. A, Vol. 39, No. 1, 19-26 (Jan., 1957).

The dispersion of magneto-optical rotation was studied in a set of eight optical glasses of known composition from 5780 to 3650 A. Dispersion formulae for optical refraction are proposed for these glasses using two mean absorption wavelengths. In all the glasses 600 A is assumed to be one absorption wavelength, but the other is varied with the composition of the glass. The experimental data on the magneto-optical rotation in each glass are fitted to a dispersion formula by using only the near u.v. absorption wavelength that is responsible for refractive dispersion. It was found that the absorption wavelength in the far u.v. (i.e. 600 A) has practically no affect on the magneto-optical rotation. The value of the anomaly factor in the glasses containing Al_2O_3, B_2O_3, BaO is low compared with the glasses containing the oxides of Pb and Zn. It was possible to establish that the network ions, like B, Al, Ba, etc., diminish the value of γ, thereby indicating the presence of covalent binding between the ions in them. A.

535.563 : 538.614

3011. FARADAY EFFECT IN GASES AND VAPORS. III.
L.R.Ingersoll and D.H.Liebenberg.
J. Opt. Soc. Amer., Vol. 48, No. 5, 339-43 (May, 1958).

For Pt II see Abstr. 6552 (1956). Verdet constants over the spectral range 3635 A to 9875 A were measured for 11 more gases and vapours (also Pyrex glass). The list includes nitric oxide gas, ammonia, and sulphur dioxide; also the vapours of water, deuterium oxide, ethyl and methyl alcohols, ether, chloroform, carbon tetrachloride, and carbon disulphide. Nitric oxide shows a negative rotation and a larger Verdet constant and Faraday dispersion than any other of the (gaseous) materials tested except carbon disulphide vapour. For comparison purposes the Verdet constants of the latter eight substances on the list were measured for the liquid state over the same spectral range. The ratio of Verdet constants for water in the liquid and vapour states is 2 to 5 times larger than for any other material tested. Deuterium oxide in vapour or liquid states shows about the same Verdet ratio to water, viz 0.97, as deuterium and hydrogen gases. Faraday temperature coefficients were determined. For constant volume conditions these are very small save for nitric oxide gas. A theoretical explanation of the rotation of nitric oxide is attempted. A.

535.565 : 535.327.3

TEMPERATURE VARIATION OF OPTICAL ROTATION OF SODIUM CHLORATE. See Abstr. 2941

535.642

3012. ACCURACY OF TRISTIMULUS COMPUTATIONS.
J.L.F. De Kerf.
J. Opt. Soc. Amer., Vol. 48, No. 5, 334-8 (May, 1958).

The methods used to compute tristimulus specifications are all approximate. In order to obtain information about the accuracy of the different weighted ordinate and selected ordinate methods, computed colour values are compared for a number of reflecting surfaces and filters. The earlier data of Nickerson are used for some of these comparisons. The only method, which determines the tristimulus specifications of all the samples studied with an uncertainty smaller than $\frac{1}{2}$ j.p.s. (just perceptible steps), is the weighted ordinate method $\Delta\lambda = 5$ mμ. To calculate the tristimulus specifications with an uncertainty of $\frac{1}{2}$ N.B.S. unit, the weighted ordinate method $\Delta\lambda = 10$ mμ and the selected ordinate method N = 100 are accurate enough, but the selected ordinate method N = 30 must be rejected. A.

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.81

3013. PROPERTIES OF ARSENIC SULFIDE GLASS.
F.W.Glaze, D.H.Blackburn, J.S.Osmalov, D.Hubbard and M.H.Black.
J. Res. Nat. Bur. Stand., Vol. 59, No. 2, 83-92 (Aug., 1957).

Samples of arsenic trisulphide glass were investigated to determine their chemical and physical properties. Among the properties reported are the hygroscopicity, chemical durability, hydrogen electrode function, expansivity, elastic moduli, modulus of rupture, hardness, transmittance, and refractive indexes. The main interest in As_2S_3 glass is for its i.r. transmittance, which extends to approximately 13 μ. Although its physical properties are inferior to those of ordinary silicate glasses, they are superior to those of some of the available materials used in i.r. optics. A.

535.81

3014. DETECTION OF STAINS FORMED ON LENS SURFACE.
K.Miyake.
Sci. of Light (Tokyo), Vol. 6, No. 3, 85-94 (Dec., 1957).

When stains are detected using reflection of light, detectable minimum optical thickness is 13-20 mμ. As the angle of incidence of the light increases, the accuracy falls. The interference colour of stained lens surfaces coated with an anti-reflection film is determined using an automatic relay computer. The results are plotted on the C.I.E. chromaticity diagram and the colour difference is calculated. The higher the refractive index of substrate glass, the smaller the detectable minimum of stain thickness when coated with anti-reflection film. Amber coating has an effect similar to a glass of low refractive index and may prevent the appearance of irregularity in the interference colour of anti-reflection coatings. A.

535.822.17

3015. CORRECTION DUE TO APERTURE IN TRANSMISSION INTERFERENCE MICROSCOPES. E.Ingelstam and L.P.Johansson.
J. sci. Instrum., Vol. 35, No. 1, 15-17 (Jan., 1958).

The fringe spacing in transmission interference microscopes is shown to require a correction due to the oblique rays, with respect to the ordinary value valid for perpendicular rays. The spacing, and accordingly the measured path differences, are smaller than the normal values (opposite to the case of reflection microscopes). Calculations are made for different values of condenser N.A. and varied parameters, showing corrections up to −15%. The fringe intensities also decrease with the order of interference when it is low. Experiments confirm these findings. The effect is discussed in relation to some general ideas of (x, y)-fidelity and (z)-fidelity as obtained in a limited optical information channel. A.

535.89

3016. A SIMPLE METHOD OF MONITORING ULTRA-VIOLET LIGHT. C.K.Coogan.
J. sci. Instrum., Vol. 35, No. 2, 64-5 (Feb., 1958).

A simple monitor was developed for indicating the progress of solarization of the walls of low-pressure Hg discharge tubes. The intensity of the Hg 5461 A radiation is compared with the green emission from a phosphor excited by Hg 2537 A radiation. An intensity match of these two greens can be arranged to occur when the solarization has reached a predetermined point. Other applications of the principle are discussed. A.

HEAT

536.2

3017. DISCUSSION OF ZIMAN'S FORMULA ON THE THERMAL CONDUCTIVITY OF CRYSTALS. J.Tavernier.
C.R. Acad. Sci. (Paris), Vol. 245, No. 26, 2490-3 (Dec. 23, 1957).
In French.

The formula (Abstr. 397/1958) is applied in the high and low temperature limits and also over the whole temperature range up to $T/\theta = 1$. Disagreement with experiment is found for Ge. E.P.Wohlfarth

536.21 : 548

3018. DETERMINATION OF THE TEMPERATURE CONDUCTIVITY COEFFICIENTS OF ETHYLENE DIAMINE TARTRATE. I.M.Sil'vestrova.
Kristallografiya, Vol. 2, No. 2, 304-7 (1957). In Russian.

The measurements were made by the unsteady state method of Zhuze and Regel' (Abstr. 6800/1953). Taking the binary axis as y and the monoclinic angle as 15.5°, the diffusivities are: $a_{11} = 3.2$, $a_{22} = 2.7$, $a_{33} = 1.8$, $a_{13} = 0.93$, all $\times 10^{-3}$ cm²/sec.

R.F.S.Hearmon

536.21 : 537.311.33

3019. THE THERMAL AND ELECTRICAL RESISTIVITY OF BISMUTH AND ANTIMONY AT LOW TEMPERATURES. G.K.White and S.B.Woods.
Phil. Mag. (Eighth Ser.), Vol. 3, 342-59 (April, 1958).

Measurements are reported of the electrical resistivity of pure polycrystalline specimens of bismuth and antimony over the range 2 to 300°K and of the thermal conductivity up to 150°K. Some measurements in a magnetic field have also been made which allow separation of the thermal conductivity into electronic and lattice components. Below 50°K, it appears that the heat conductivity of bismuth is nearly all due to lattice waves; free electrons seem to contribute little to the conduction or to the scattering. In antimony, however, the lattice conductivity is smaller than might be expected at low temperatures suggesting significant scattering by free electrons. The electronic term, λ_e, in antimony is remarkably similar in its temperature dependence to that in a monovalent metal. The electrical resistivity of both elements varies as about $T^{2.75}$ for $T \leq \theta/10$. For bismuth the approximate proportionality of resistivity with temperature observed at normal temperatures extends to rather lower temperatures than is usual in a metal. A.

536.21.07

3020. AN APPARATUS FOR MEASUREMENT OF THERMAL CONDUCTIVITY OF SOLIDS AT LOW TEMPERATURES. R.L.Powell, W.M.Rogers and D.O.Coffin.
J. Res. Nat. Bur. Stand., Vol. 59, No. 5, 349-55 (Nov., 1957).

The apparatus can be used for determining the thermal conductivities of solids in the temperature range 4° to 300°K. The apparatus is especially suited to the determination of thermal conductivity over a large temperature interval, enabling coverage of the temperatures between the normal boiling points of liquefied gases. Illustrative results are given for an insulator, polytetrafluoroethylene, and for a high-conductivity commercial coalesced copper. The thermal conductivity of the insulator increases monotonically from 0.56 mW cm^{-1}(deg K)$^{-1}$ at 5°K, to 2.32 at 80°K. The thermal conductivity of the Cu has a maximum of 24.9 W cm^{-1}(deg K)$^{-1}$ at 21°K, and a value of 8.15 at 5°K. The methods of data analysis and estimation of errors are given. A.

536.21.08

3021. THERMAL CONDUCTIVITY OF BERYLLIUM OXIDE FROM 40° TO 750°C. D.A.Ditmars and D.C.Ginnings.
J. Res. Nat. Bur. Stand., Vol. 59, No. 2, 93-9 (Aug., 1957).

The thermal conductivity of BeO was measured by an absolute method from 40° to 750°C. The apparatus employed steady-state, longitudinal heat-flow along a rod of high-fired BeO, surrounded by a tube with matching temperature gradient to minimize radial heat loss. The estimated accuracy of the measurements is about 3%. However, the values of thermal conductivity of the ideal BeO crystal are probably considerably higher than the values given, because of the lower density (87% theoretical) of the sample used. A.

536.212.2 : 531.717

3022. EXPERIMENTS USING A SIMPLE THERMAL COMPARATOR FOR MEASUREMENT OF THERMAL CONDUCTIVITY, SURFACE ROUGHNESS AND THICKNESS OF FOILS OR OF SURFACE DEPOSITS. R.W.Powell.
J. sci. Instrum., Vol. 34, No. 12, 485-92 (Dec., 1957).

The thermal comparator described consists of two metal balls similarly mounted in a block of balsa wood, but one is at a slightly lower level so that it touches any surface on which the block rests. After heating to a small fixed temperature excess, the block is laid in contact with the test surface. Differentially connected thermocouples attached to each ball measure the increased rate of cooling of the ball that makes contact. The differential e.m.f. is observed 10 sec after contact is made and is shown to be a function of the thermal conductivity of the material on which the ball rests. When calibrated in terms of at least two substances of known thermal conductivity, determinations of thermal conductivity can be quickly made. The accuracy from single readings made on several alloys of Fe, Al and Mg is about ±6%, but Pb departs considerably, due, it is thought, to its softness. The condition of the surface affects the readings, so the calibration should be made for a similar surface condition. Alternatively, the device can be used as a means of measuring surface finish. Other possible uses are for measuring the thickness of surface deposits and for non-destructive sorting or identification of solid materials. A.

536.212.2.08

3023. THERMAL CONDUCTIVITY OF NICKEL AND URANIUM. G.J.Pearson, P.O.Davey and G.C.Danielson.
Proc. Iowa Acad. Sci., Vol. 64, 461-5 (1957).

An improved form of apparatus for measuring the thermal conductivity of metals at high temperatures by the gradient comparison method is described. Data obtained for commercial A (99.54%) Ni and for U, in the range from 150° to 650°C, are shown graphically and compared with those of other workers. S.Weintroub

536.22 : 536.23

3024. THE THERMAL CONDUCTIVITY OF NITROGEN AND ARGON IN THE LIQUID AND GASEOUS STATES. H.Ziebland and J.T.A.Burton.
Brit. J. appl. Phys., Vol. 9, No. 2, 52-9 (Feb., 1958).

The thermal conductivity of nitrogen and argon was measured with a vertical coaxial cylinder apparatus. The investigation included the critical region and covered the temperature range from 85° to 200°K at pressures between 1 and 135 atm. The results obtained in this research agree well with those obtained by most other authors. A.

536.23.08

3025. THERMAL CONDUCTIVITY OF NITROGEN FROM 50° TO 500°C AND 1 TO 100 ATMOSPHERES. R.L.Nuttall and D.C.Ginnings.
J. Res. Nat. Bur. Stand., Vol. 58, No. 5, 271-8 (May, 1957).

A new apparatus was constructed for measurements of the thermal conductivity of gases up to 500°C and 100 atm pressure. The parallel-plate method was used with a spacing of about 0.5 mm between the hot-plate and cold-plate. A capacitance method was used to measure the effective spacing and area of the plates under conditions of the experiment. No solid material was used between the plates. The effect of radiation was minimized by use of polished silver parts and was accounted for by experiments with the conductivity cell evacuated. Measurements on nitrogen were made at 1, 50 100 atm, and from 50° to 500°C. It is believed that the accuracy of the results is about 0.5%, except at the highest gas densities. A.

536.33.08

3026. MEASUREMENT OF INTENSE BEAMS OF THERMAL RADIATION. A.Broido and A.B.Willoughby.
J. Opt. Soc. Amer., Vol. 48, No. 5, 344-50 (May, 1958).

Thermal radiation calorimeters have been constructed with relatively thick receivers which permit the direct recording of integrated thermal energy dose as a function of time. However, it is shown that with proper receiver design the rate of change of recorded temperature can be made proportional to the rate of delivery of energy within a reasonably short time constant. Thus, differentiation of the recorded temperature data will give an accurate picture of the irradiance-time history of an impinging pulse. Several hundred calorimeters have been successfully used, both in the laboratory and in the field, to measure, with a time constant of 20 milliseconds or less, radiant energy pulses up to 100 cal.cm^{-2} with peak irradiances up to 200 cal.cm^{-2}.sec^{-1}. The primary advantages of the instruments are that they are small, simple, rugged and that they provide a signal which may be recorded without complex amplification equipment directly on a high-speed oscillographic recorder. A.

536.33.08 : 621.317.794 : 621.317.733

3027. A SELF-BALANCING DIRECT-CURRENT BRIDGE FOR ACCURATE BOLOMETRIC POWER MEASUREMENTS. G.F.Engen.
J. Res. Nat. Bur. Stand., Vol. 59, No. 2, 101-5 (Aug., 1957).

Until recently, the most accurate microwave power measurements of the bolometric type have required the use of a manual d.c. bridge. A self-balancing d.c. bridge was developed that preserves the inherent accuracy of the manual bridge, extends the dynamic range of operation, and greatly simplifies the operating procedure. A general description of the equipment and operating techniques is given, followed by a comprehensive survey of the sources of error accompanying the method and the accuracy achieved. A.

536.4 : 539.213.22

3028. COOLING TIME OF STRONG GLASS FIBERS. O.L.Anderson.
J. appl. Phys., Vol. 29, No. 1, 9-12 (Jan., 1958).

Simplified equations for the cooling time of glass fibres to the solid state are deduced from the theory of heat conduction. The

approximations made are based upon a value of the order of 1 for Nusselt's number. This value of N_u holds for comparable metallic fibres, as measured by Mueller, and is assumed to hold for glass fibres. The relation of pulling speed and flow rate to cooling time is shown. Calculations of cooling time of typical small glass fibres show that they are of the same order as the Maxwell relaxation time of the glass at roughly 900°C. The consequence of this correlation is discussed in terms of the high strength of fibres, and the high "fictive" temperature of fibres. See also Abstr. 2939 (1958). A.

536.42

3029. [CONTRIBUTION] TO THE THEORY OF PHASE TRANSITIONS.
N.N.Bogolyubov, D.N.Zubarev and Yu.A.Tserkovnikov.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 5, 788-91 (1957). In Russian.

The Hamilton function of an assembly of electrons in a superconducting metal is at first formulated in terms of the standard fermion field operators. A canonical transformation, involving a linear combination of the field operators, is considered; in terms of the transformed field operators the interaction energies are to become bilinear functions (as distinct from the original quadrilinear functions). The partition function is evaluated using successfully techniques of the theory of radiation. From the properties of the partition function a condition is deduced which determines the coefficients of the above transformation. This condition assumes the form of a transcendental equation for a temperature-dependent quantity that enters the partition function. By solving the equation it is shown that there is a critical temperature corresponding to a transition of the second order. R.Eisenschitz

536.421.1 : 539.893

3030. INVESTIGATION OF PHASE TRANSITIONS AT SUPER-HIGH PRESSURES. V.P.Butuzov.
Kristallografiya, Vol. 2, No. 4, 536-47 (1957). In Russian.

A method of producing pressures up to 34000 Kg/cm^2 is described. It is applicable to liquids up to 600° C and to gases up to 1500° C. The effect of pressure on melting point in Sn, Tl, Cd, Pb, Zn, Sb, Cu and Al was measured and is shown graphically. The phase constitution diagram of Bi is obtained; polymorphic transitions in Bi and in P are also investigated. R.F.S.Hearmon

536.421.2

3031. ON THE SURFACE TEMPERATURE OF MELTING SNOW.
A.A.Dmitrev, K.Ya.Kondrat'ev, Z.A.Loginova and K.E.Yakushevskaya.
Vestnik Leningrad. Univ. Ser. Fiz. Khim. No. 3 (1957) No. 16, 49-54. In Russian.

The authors used three different devices to take, and compare, measurements of the surface temperature of melting snow. A positive temperature of the melting snow surface was observed and an explanation for this is put forward in the paper.

C.R.S.Manders

536.421.4

3032. CRYOSCOPIC ASSEMBLY FOR PRECISE MEASUREMENTS UNDER CONTROLLED ATMOSPHERES AT TEMPERATURES UP TO 500°C. C.Solomons and G.J.Janz.
Rev. sci. Instrum., Vol. 29, No. 4, 302-4 (April, 1958).

A cryoscope is described which was designed for the accurate measurement of freezing points of molten salts under controlled atmospheres. It possesses several advantages over apparatus in the published literature, especially when used with solutions which attack or embrittle the glass container. The ancillary apparatus used with the cryoscope is also described, and the features of the apparatus are discussed. Examples are given to show how several problems of molten salt cryoscopy under controlled atmosphere have been satisfactorily overcome. A.

536.422 : 548.5

3033. ROLE OF CRYSTAL EDGES IN EVAPORATION.
G.W.Sears.
J. chem. Phys., Vol. 27, No. 6, 1308-9 (Dec., 1957).

Direct experimental evidence is presented to show that crystal edges may serve as a source of steps for evaporation. Thus even a perfect crystal can evaporate at low undersaturations. A.

536.423 : 532.525

3034. THE EVAPORATION OF SPRAYS. R.T.Jarman.
Brit. J. appl. Phys., Vol. 9, No. 4, 153-4 (April, 1958).

The rate of evaporation of an aircraft spray of kerosene droplets in the atmosphere was measured, and found to approximate to the theoretical estimates. A.

536.461 : 541.127

3035. SODIUM DIFFUSION FLAME METHOD FOR FAST REACTIONS. THE USE OF A SPHERICAL SOURCE.
J.F.Reed and B.S.Rabinovitch.
J. chem. Phys., Vol. 27, No. 4, 988-9 (Oct., 1957).

The diffusion flame method of studying fast reactions of Na atoms is modified by using as source a hollow steel sphere drilled with 24 small holes. The resulting spherical flame is more amenable to mathematical treatment than that from a nozzle. For the flame with CH_3Cl at 598° K, the rate constant is found to be 6.6×10^{11} cm^3/mole.sec, compared with 1.1×10^{11} by the nozzle method. A.G.Gaydon

536.461

3036. FLOW FIELD OF A BUNSEN FLAME.
M.S.Uberoi, A.M.Kuethe and H.R.Menkes.
Phys. Fluids, Vol. 1, No. 2, 150-8 (March-April, 1958).

The flow field of a two-dimensional Bunsen flame is examined by approximating the zone of combustion by a surface of discontinuity across which the density drops and normal velocity increases. Even though the flow of unburned gases is potential, the flow of the burned gases is always rotational and is therefore not amenable to complete analysis. Interaction of flame shape and flow field is obtained analytically and experimentally. The entire flow field of unburned and burned gases is mapped by taking stroboscopic photographs of small particles suspended in the combustible gases. The measured flow field is considered in the light of the above analysis. A.

536.462 : 536.52

3037. USE OF AN ELECTRO-OPTICAL METHOD TO DETERMINE DETONATION TEMPERATURES IN HIGH EXPLOSIVES.
F.C.Gibson, M.L.Bowser, C.R.Summers, F.H.Scott and C.M.Mason.
J. appl. Phys., Vol. 29, No. 4, 628-32 (April, 1958).

A method has been devised for sampling the optical radiation from the interior of a detonating solid-explosive charge by introducing a transparent plastic rod axially into the charge at the time of fabrication. The radiation was analysed by a grating spectrograph, using four bands 100 A wide and 600 A apart. The radiation intensities were used to calculate the colour temperatures within the detonating explosive. The apparatus was calibrated by a radio-frequency-excited lamp known to have gray-body radiation. The explosive charges were vacuum-impregnated with propane to replace the air in the intergranular voids to eliminate light emission from the air shock. A.

536.462

3038. SPECTROSCOPIC STUDY OF ELECTRONIC FLAME TEMPERATURES AND ENERGY DISTRIBUTIONS.
H.P.Broida and K.E.Shuler.
J. chem. Phys., Vol. 27, No. 4, 933-9 (Oct., 1957).

A spectroscopic study was made of electronic temperatures and electronic excitation in flames from an analysis of the intensity distribution of selected parts of the iron spectrum. The iron was added to the flames in the form of ferrocene to serve as a temperature and excitation "indicator". The flames investigated were the stoichiometric H_2-O_2 and $C_2H_2-O_2$ flames at atmospheric pressure, a stoichiometric $C_2H_2-O_2$ flame at low pressure (2.1 mm) and a N + CO atomic flame (3.7 mm). This study shows that the iron spectrum can be used as a spectroscopic "thermometer" to determine electronic temperatures in good agreement with adiabatic flame temperatures and OH rotational temperatures in flame regions at thermal equilibrium. The reaction zones of the $C_2H_2-O_2$ and N + CO flames showed a marked departure from equilibrium as indicated by the non-thermal excitation of the added iron, the observed iron spectrum resembling that of an iron arc. This non-thermal excitation of the iron spectrum, which is readily evidenced by the appearance of iron lines originating from high energy levels ($E_n' \geq 50\,000$ cm^{-1}), can serve as a very sensitive indicator of the departure from equilibrium in a high temperature reaction system. A brief discussion is given of the possible chemical and energy exchange mechanisms which may give rise to the abnormal excitation of iron in various reaction systems. A.

536.48 : 536.55

3039. SOME THERMAL PROPERTIES OF HELIUM AND THEIR RELATION TO THE TEMPERATURE SCALE.
R.Berman and C.F.Mate.
Phil. Mag. (Eighth Ser.), Vol. 3, 461-9 (May, 1958).

Values have been obtained for the latent heat and saturated vapour density of helium between 2.2° K and 5.2° K, and the critical

constants have been re-assessed. It is shown how the calculated vapour density may be used to examine the consistency of a liquid-helium temperature scale. A.

536.48

3040. THE ANGULAR ACCELERATION OF LIQUID HELIUM II. H.E.Hall.
Phil. Trans A, Vol. 250, 359-85 (Dec. 12, 1957).

Direct measurements have been made of the torques required to produce angular acceleration and retardation of liquid helium II contained in a can filled with closely spaced disks at a temperature of 1.27°K. The acceleration and retardation processes are not equivalent, and it is suggested that this asymmetry is due to the presence of vortex lines in the uniformly rotating superfluid. It is found that the forces producing superfluid acceleration are dependent on the past history of the helium and are greatly enhanced if the disk surfaces are roughened; furthermore, the superfluid flow shows a strong tendency to be macroscopically irrotational during retardation. These properties suggest that the forces are associated with turbulence in the superfluid, and it is found that a consistent description of the results can be given in terms of a mutual friction due to such turbulence. Values of the mutual friction appropriate to a steady flow are deduced and found to be in good agreement with values deduced from the results of other isothermal flow experiments; they can be represented, above a critical velocity, by a modification of the law introduced by Gorter and Mellink (1949), namely $F_{sn} = A\rho_s\rho_n(|v_s - v_n| - v_0)^2(v_s - v_n)$, with $A = 23 \pm 2$ poise^{-1}, $v_0 = -0.6 \pm 0.2$ cm.sec^{-1}. Below the critical velocity a persistent current with a lifetime of at least 25 min has been observed. In the last section quantitative results on the growth and decay of turbulence in a non-equilibrium situation are presented, and laws describing the growth and decay processes are formulated. A.

536.48

3041. MUTUAL FRICTION IN A HEAT CURRENT IN LIQUID HELIUM II. IV. CRITICAL HEAT CURRENTS IN WIDE CHANNELS. W.F.Vinen.
Proc. Roy. Soc. A, Vol. 243, 400-13 (Jan. 14, 1958).

For Pt III see Abstr. 154 (1958). Experiments are described in which a heat current in a wide channel is suddenly increased from a small value W_1 to a large value W_2; the time characterizing the build-up of the Gorter–Mellink mutual friction to its equilibrium value in the heat current W_2 is studied as a function of W_1. Interpretation of the results on the basis of the idea that the mutual friction is associated with turbulence (in the form of vortex lines) in the superfluid shows that some mutual friction exists in the heat current W_1 even when the latter is less than the critical value described in Pts I and II (Abstr. 6120-1/1957), and that, as the channel width is increased or the temperature raised, the magnitude of the subcritical mutual friction increases until the critical heat current ceases to exist. It is shown that these observations on mutual friction in small heat currents can be described semi-quantitatively if a single term is added to the expression obtained in Pt III for the length of vortex line per unit volume in a heat current in a channel of infinite width, and that this term can probably arise either from an annihilation of vortex lines at the walls of the channel or from interference by the walls with the mechanisms of growth and decay of superfluid turbulence discussed in Pt III. Finally, an explanation is suggested of some of the results described in Pt II on the decay of mutual friction in the presence of a subcritical heat current. A.

536.48

3042. FLOW INSTABILITY OF A SUPERFLUID FILM. R.G.Arkhipov.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 116-23 (1957). In Russian.

Instability of flow of a superfluid liquid in a film on appearance of wave motion on its surface is theoretically shown to exist. The derived critical velocity exceeds appreciably the experimental value. The shape of a He II film moving in a gravitational field was determined by taking into account hydrodynamical forces, surface tension and van der Waals forces. A.

536.48 : 534.22

3043. MEASUREMENTS ON THE VELOCITY OF SOUND IN HELIUM GAS AT LIQUID HELIUM TEMPERATURES. CALCULATION OF THE SPECIFIC HEATS. A.van Itterbeek and W.de Laet.
Physica, Vol. 24, No. 1, 59-67 (Jan., 1958).

The velocity of sound in helium gas was measured as a function of pressure between the boiling point and 2°K. A method based on audible sound was used. Measurements were made between 1 atm and ± 2.5 mm. The velocity measurements are extrapolated to the vapour pressure at the different temperatures. No discontinuity is found at the λ-point for the velocity as a function of temperature. The ratio of the specific heats and the specific heats themselves were calculated as a function of pressure at different temperatures. For C_v as a function of pressure curves are found with a very pronounced minimum, which becomes steeper as the temperature decreases. A.

536.48 : 534.22

VELOCITY OF ULTRASONIC WAVES IN LIQUID HELIUM.
See Abstr. 2897

536.48 : 532.7 : 534.22

ABSORPTION AND DISPERSION OF SOUND IN LIQUID HELIUM.
See Abstr. 2898

536.491

3044. A PROBLEM IN SELF-HEATING OF A SPHERICAL BODY. S.M.Genensky.
J. Res. Nat. Bur. Stand., Vol. 59, No. 2, 79-81 (Aug., 1957).

An analytic steady-state solution is developed for a spherical body in which heat is generated according to a first-order unimolecular-reaction law, and lost at the surface in accordance with Newton's law of cooling. The temperature within the sphere depends chiefly on the radial distance from the centre, but also on the ambient temperature, the surface heat-loss coefficient, and the material properties, which are assumed constant. A.

536.5.081

3045. THERMODYNAMIC TEMPERATURE SCALE (T_{L55}) IN THE LIQUID HELIUM REGION. H.van Dijk and M.Durieux.
Physica, Vol. 24, No. 1, 1-19 (Jan., 1958).

An outline is given of the way in which an accurate temperature scale for the liquid helium region, the T_{L55}-scale, has been obtained at Leiden. (1) Introduction. (2) Thermodynamic pT-relation. (3) Calculation of the principal terms from experimental data. (4) Calculation of the correction terms from experimental data. (5) Provisional Leiden 1955 scale. (6) Extension of the scale up to 5.2°K. (7) Consistent set of values for the boiling points of O_2, H_2 and He. (8) The heat of the vaporization of He^4. (9) Accuracy and comparison with other results. (10) Numerical calculation of T_{L55}, a table containing an abstract of the complete table of p as a function of T, and a table containing the basic data for the calculation of the complete table. A.

536.5.081.4

3046. THE TRIPLE POINT OF ARGON AS A THERMOMETRIC FIXED POINT. R.A.H.Pool, B.D.C.Shields and L.A.K.Staveley.
Nature (London), Vol. 181, 831 (March 22, 1958).

A fresh determination was made using the method of Michels, Wassenaar, Sluyters and de Graaf (Abstr. 8570/1957). The average value was 516.82 ± 0.04 mm for the triple-point pressure and the temperature was 83.783 ± 0.006°K. E.H.Dock

536.512

3047. THE EMERGENT COLUMN CORRECTION IN MERCURY THERMOMETRY. J.A.Hall and V.M.Leaver.
J. sci. Instrum., Vol. 35, No. 3, 93-6 (March, 1958).

The conditions are discussed which determine the accuracy of measurement of the emergent column temperature when Hg thermometers are used at partial immersion. The method of measuring the emergent column temperature used at the National Physical Laboratory is described, a table of the average values experienced is given, and the reasons in favour of testing thermometers at the immersion at which they are to be used are explained. A.

536.52

3048. THE VENTURI PNEUMATIC PYROMETER. A.M.Godridge, R.Jackson and G.G.Thurlow.
J. sci. Instrum., Vol. 35, No. 3, 81-8 (March, 1958).

An instrument for measuring gas and flame temperatures is described. From design considerations it is shown that the instrument can be used at higher temperatures than existing probe instruments and have a very rapid rate of response. The operation of the instrument is discussed and examples of its use are given. In the down takes of open-hearth furnaces and in water-tube boilers the instrument shows advantages over the suction pyrometer in speed of response and freedom from blockage. Results were also obtained at temperatures higher than those at which any other method of obtaining local temperatures has proved successful. A.

536.628.2

3049. AN AUTOMATIC ADIABATIC BOMB CALORIMETER. W.F.Raymond, R.J.Canaway and C.E.Harris.
J. sci. Instrum., Vol. 34, No. 12, 501-3 (Dec., 1957).

The conversion is described of an existing isothermal bomb

calorimeter to an adiabatic calorimeter with automatic control. Thermistors in the inner and outer vessels are included in two arms of an a.c. Wheatstone bridge: any rise in temperature of the inner vessel above that of the outer vessel results in phase reversal of the output voltage from the bridge, which operates a gas-filled tetrode controlling a 500 W heater in the outer vessel. A second tetrode, operated by off-balance voltage, controls a 1000 W heater in the outer vessel, which accommodates the initial rapid temperature rise when the bomb is fired. The equipment was found to be more rapid and much less tedious for routine use than the usual isothermal method. Determinations of heat content take approximately thirty minutes. The coefficient of variation of a single determination, with an average temperature rise of 1.9 deg. C, is 0.34%. A.

536.631

3050. THE TEMPERATURE DEPENDENCE OF THE THERMAL CAPACITY OF SOLID BODIES. N.N.Sirota.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 5, 901-3 (1957). In Russian.

Debye's distribution function of the modes of vibration on the frequency scale is replaced by the expression const. $\nu^2\exp(-2h\nu/k\Theta)$, where the symbols have their usual meaning. This formula is applied to all possible values of frequencies, no cut-off being required. The value of the characteristic temperature is to be taken much smaller than Debye's value. Hence the following expression for the specific heat is derived

$$C_V = 3R(T/\Theta)^3[(2T/\Theta) + 4]/[(T/\Theta) + \tfrac{1}{2}]^4.$$

While no attempt is made to justify these formulae from the point of view of theory, it is claimed that agreement with experiment is good. R.Eisenschitz

536.631

3051. HEAT CAPACITY OF Cu_3Au BELOW 4.2°K. J.A.Rayne.
Phys. Rev., Vol. 108, No. 3, 649-51 (Nov. 1, 1957).

Measurements were made in both the disordered and ordered states. It was found that ordering increases the Debye temperature of the lattice, but that it leaves the electronic heat capacity substantially unchanged at a value in excess of that for free electrons. An explanation of the latter observation is proposed in terms of the changes in Brillouin zone structure that are presumed to take place on ordering. The values of Debye temperature do not agree with those obtained from low-temperature resistance measurements, but are in good agreement with the value computed from the room-temperature elastic constants of ordered Cu_3Au. A.

536.631 : 538.221

3052. NUCLEAR MAGNETIC INTERACTION IN AN ANTIFERROMAGNETIC CRYSTAL. A.H.Cooke and D.T.Edmonds.
Proc. Phys. Soc., Vol. 71, Pt 3, 517-19 (March, 1958).

Measurements are reported of the specific heat of manganous fluoride between 0.5° and 2° K. Below about 68° K MnF_2 is antiferromagnetic and the alignment of the Mn ions leads, by hyperfine interaction, to an appreciable alignment of the Mn nuclei below 1° K. The measurement of the resulting specific heat anomaly gave a value for the hyperfine coupling constant in good agreement with previous determinations by other methods. The possibility of studying nuclear alignment in antiferromagnetics is discussed. D.J.Oliver

536.631

3053. MEASUREMENT OF THE ATOMIC HEATS OF PURE PALLADIUM AND OF PALLADIUM CONTAINING HYDROGEN. W.Eichenauer and L.Schäfer.
Z. Naturforsch., Vol. 11a, No. 11, 955-6 (Nov., 1956). In German.

The atomic heats between 55 and 270°K were determined for pure Pd, and for Pd charged electrolytically with hydrogen to contents of 11.8 and 16.3 atomic % respectively, by the method of Eucken and Clusius (1936). Brief experimental details with data curves are given, the latter indicating slightly higher values (0.5-1%) than those reported by Clusius and Schachinger (Abstr. 3193/1947). From the temperature/atomic-heat relationship it is concluded that in the Pd—H system no phase transformations occur within the temperature range investigated such as occur in the Ta—H system. H.H.Hodgson

THERMODYNAMICS

536.7

3054. CORRELATION BETWEEN THE DEFINITION OF ENERGY AND ITS CONSERVATION. EXTENSION TO SYSTEMS WITH MANY PARAMETERS WITHOUT EXCHANGE OF MATTER.
P.Renaud, M.Joly and D.G.Dervichian.
C.R. Acad. Sci. (Paris), Vol. 245, No. 25, 2213-16 (Dec. 16, 1957). In French.

The definition given previously (Abstr. 7361/1956) relating to systems of a single parameter is extended to systems of many parameters. S.Weintroub

536.7 : 536.655

3055. THERMODYNAMIC FUNCTIONS OF CYCLOBUTENE. A.Danti.
J. chem. Phys., Vol. 27, No. 5, 1227 (Nov., 1957).

Presents a table of values of H, F, S and C_p, at ten temperatures from 275°K to 1500°K, calculated assuming a rigid rotator with harmonic vibrations, and neglecting vibration—rotation interactions. J.Hawgood

536.7

3056. THERMODYNAMIC PROPERTIES OF GAS HYDRATES. J.C.Platteeuw and J.H.van der Waals.
Molecular Phys., Vol. 1, No. 1, 91-6 (Jan., 1958).

A statistical mechanical description based on the Lennard-Jones and Devonshire model is applied. The theory enables one to calculate dissociation pressures, compositions and heats of dissociation of several such gas hydrates. The agreement between the calculated values and the experimental data at present available supports the theory. A.

ELECTRICITY

ELECTROSTATICS. DIELECTRICS

537.221

3057. THE GENERATION OF STATIC CHARGE. W.R.Harper.
Advances in Phys., Vol. 6, 365-417 (Oct., 1957).

Experiments and theories on the electrostatic charging produced by (i) the bubbling of a gas through a liquid, and the spraying and shattering of drops, (ii) a liquid when flowing in contact with a solid, (iii) the contact between solids, are dealt with at some length. Reference is also made to the separation of charge which occurs when water freezes and to the generation of charge in a thunderstorm. A.E.Kay

537.221

3058. ELECTRIFICATION OF MICA CRYSTALS ON SPLITTING. M.S.Metsik.
Zh. tekh. Fiz., Vol. 28, No. 1, 109-13 (1958). In Russian.

Three methods of measuring electrification of mica crystals on splitting are described. These work with moving or stationary, pencil-type probes which collect either conducted or induced charges. Evaluation of the experimental results and their comparison with results of X-ray analysis enabled author to suggest a model of the muscovite and phlogopite lattice with a water-interlayer. According to this model electrification is due to the effect of separation of heterogeneous surfaces. Electrical Research Association

537.222.2 : 537.311.33

3059. EXACT CURRENT—VOLTAGE RELATION FOR THE METAL—INSULATOR—METAL JUNCTION WITH A SIMPLE MODEL FOR TRAPPING OF CHARGE CARRIERS. G.H.Suits.
J. appl. Phys., Vol. 28, No. 4, 454-8 (April, 1957).

The exact solution to the diffusion equation for one kind of charge carrier is obtained for the metal—insulator—metal junction where trapping of the charge carriers may occur in the body of the insulator. The effect of surface states is not considered. The electric potential distribution is given in closed form and the exact d.c. current-voltage relation is given in parametric form for any degree of trapping. A graph of the current-voltage relation is shown for the special case where the two boundary metals are the same. A brief description of some experimental difficulties is given when test junctions were prepared entirely by the vacuum evaporation method. A.

537.226.1

3060. ON THE MOLECULAR THEORY OF DIELECTRIC POLARIZATION. M.Mandel and P.Mazur.
Physica, Vol. 24, No. 2, 116-28 (Feb., 1958).

A general statistical mechanical formalism is presented which yields a closed expression for the dielectric constant of a system of polarizable dipoles in terms of averages over molecular quantities. The validity of this general formula is not restricted to a spherical sample. Some general aspects of the theory of dielectric polarization are discussed on the basis of the present formalism. An explicit expression is also derived for the total electrostatic energy of the system. A.

537.226.1

3061. THE IMPORTANCE OF OPTICAL INVESTIGATION OF ROCHELLE SALT DOMAINS FOR THE THEORY OF FERROELECTRICS. V.L.Indenbom and M.A.Chernȳsheva.
Kristallografiya, Vol. 2, No. 4, 526-35 (1957). In Russian.

An optical method based on the difference between extinction positions of opposite domains may be used to observe the domain structure directly and to study the effect on it of electrical and mechanical fields. The choice of spontaneous angle of rotation of the optical indicatrix as a measure of monoclinicity allows the temperature variation of the latter quantity to be determined.
R.F.S.Hearmon

537.226.1.08

3062. A THREE-CENTIMETRE MICROWAVE BENCH FOR STUDYING THE PRESSURE AND TEMPERATURE EFFECTS ON DIELECTRIC BEHAVIOUR OF GASES. Krishnaji and G.P.Srivastava.
J. sci. industr. Res., Vol. 16A, No. 7, 289-94 (July, 1957).

A detailed description of apparatus, with tables of results on ethyl chloride over a range of p and T. K.W.Plessner

537.226.2 : 539.21

3063. SOME MEASUREMENTS OF THE DIELECTRIC PROPERTIES OF ROCHELLE SALT EXPOSED TO X-RAYS. I.Ya.Éĭsner.
Kristallografiya, Vol. 2, No. 2, 296-9 (1957). In Russian.

X-cut crystals of Rochelle salt were exposed to 30 kV X-rays for 10, 20 and 40 hrs. The 50 c/s permittivity at the Curie points was approximately halved between 10 and 40 hrs; further irradiation caused only a small reduction in permittivity. In electric fields up to 1000 V/cm, the dependence of permittivity on field strength was more marked in the irradiated specimens. The permittivity between 500 and 5000 kc/s was not very sensitive to radiation; the measured value in unirradiated salt for these frequencies at 17°C was $\epsilon = 120$. These effects are discussed in terms of the colour centres in the crystal. The effect of radiation on the hysteresis loops is also discussed. See also Abstr. 7848 (1957). R.F.S.Hearmon

537.226.2 : 621.315.611

3064. INFLUENCE OF MOISTURE UPON THE DIELECTRIC PROPERTIES OF SOLID POWDERS DISPERSED IN LIQUID PARAFFIN. R.Gotohi, T.Hanai and N.Koizumi.
Nature (London), Vol. 181, 406-7 (Feb. 8, 1958).

The suspensions showed a Schweidler type of dispersion, in which both $\epsilon' - \epsilon_\infty$ and ϵ'' are proportional to ω^{-m}, m being a constant. Thorough drying eliminated the effect and resulted in an almost loss-free dielectric. K.W.Plessner

537.226.2 : 538.221

3065. DIELECTRIC SPECTROSCOPY OF FERROMAGNETIC SEMICONDUCTORS. P.A.Miles, W.B.Westphal and A.von Hippel.
Rev. mod. Phys., Vol. 29, No. 3, 279-307 (July, 1957).

A review of recent measurements of the complex dielectric permittivity and magnetic permeability of ferromagnetic spinels (ferrites) over the frequency range from static measurements to ultraviolet frequencies. The measuring techniques applicable to different parts of the frequency range are briefly described. There is a general discussion of the interpretation of electric and magnetic spectra, and a detailed discussion of the magnetic effects in the ferrites. L.E.Cross

537.226.2

3066. INVESTIGATION OF TEMPERATURE–FREQUENCY DEPENDENCES OF DIELECTRIC LOSS-ANGLE TANGENT AND PERMITTIVITY OF CERTAIN POLYESTERS OF METHACRYLIC ACID. G.P.Mikhaĭlov and T.I.Borisova.
Zh. tekh. Fiz., Vol. 28, No. 1, 137-42 (1958). In Russian.

537.226.2

3067. STUDY OF THE TEMPERATURE DEPENDENCE OF DIELECTRIC LOSSES AND PERMITTIVITY OF POLYMERS IN THE CENTIMETRE WAVELENGTH REGION (λ = 3.3 AND 10 cm). I. TECHNIQUE OF MEASUREMENT OF TAN δ AND ϵ' IN THE TEMPERATURE RANGE −100 TO +200°C AT V.H.F. II. POLYETHYLENE, POLYTETRAFLUORETHYLENE, POLYSTYRENE, POLYMETHYLMETHACRYLATE, POLYCAPROLACTAM, EBONITE. G.P.Mikhaĭlov and A.M.Lobanov.
Zh. tekh. Fiz., Vol. 28, No. 2, 267-72, 273-8 (1958). In Russian.

537.226.2 : 538.221

3068. RADIOFREQUENCY [2×10^5-6×10^7 c/s] SPECTRA OF PERMEABILITY AND PERMITTIVITY OF THE BODY [TELA] AND SUBSTANCE [VESHCHESTVA] OF MnZn FERRITES. L.A.Fomenko.
Zh. tekh. Fiz., Vol. 28, No. 3, 506-10 (1958). In Russian.

537.226.2

3069. FERROELECTRIC PROPERTIES OF GLYCINE SULPHATE. L.Taurel, E.Pourel and F.Thomassin.
C.R. Acad. Sci. (Paris), Vol. 246, No. 1, 70-2 (Jan. 6, 1958). In French.

The spontaneous polarization and 50 c/s coercive field were measured over the temperature range from −70°C to the Curie temperature (θ) at about 47°C. It is stated that P/P_S as a function of the reduced temperature $T - \theta$ is identical to the similar function for potassium dihydrogen phosphate. L.E.Cross

537.226.2

3070. TRANSACTIONS OF FIRST CONFERENCE ON FERROELECTRICS.
Izv. Akad. Nauk,SSSR Ser. fiz., Vol. 21, No. 2, 233-92 (1957). In Russian.

"Survey of progress in research on ferroelectrics", G.A. Smolenskiĭ, (233-63); "Orientation of domains and macrosymmetry of the characteristics of ferroelectric monocrystals", I.S.Zheludev and L.A.Shuvalov, (264-74); "Crystal chemistry of ferroelectrics of perovskite-type structure", Yu.N.Venevtsev and G.S.Zhdanov, (275-85); "Character of the change of the domain structure of Seignette salt in alternating electric fields", I.S.Zheludev and R.Ya.Sitko, (286-8); "Some details of the domain structure of Seignette salt crystals (from optical observations)", M.A.Chernȳsheva, (289-92).
Electrical Research Association

537.226.2 : 548.4

3071. POLARIZATION CHARACTERISTICS OF ROCHELLE SALT CRYSTALS CONTAINING IMPURITIES.
V.P Konstantinova and V.A.Yurin.
Kristallografiya, Vol. 2, No. 2, 294-6 (1957). In Russian.

Curves are given for permittivity as a function of voltage gradient in Rochelle salt containing B, Al and Cu as impurities. The dependence of permittivity on temperature was measured for Cu-adulterated specimens cut from the (010), (120) and (001) crystal faces. In the case of the (001) specimens, there is a considerable lowering of the permittivity peaks at the Curie points and a decrease in the temperature interval between the Curie points. The (001) specimens also show double hysteresis loops, but the loops can be restored to the usual shape by annealing. R.F.S.Hearmon

537.226.2

3072. DIELECTRIC POLARIZATION OF [FERROELECTRIC] CADMIUM PYRONIOBATE [$Cd_2Nb_2O_7$] AND CERTAIN SOLID SOLUTIONS BASED ON IT. V.A.Isupov and O.K.Khomutetskiĭ.
Zh. tekh. Fiz., Vol. 27, No. 12, 2704-17 (1957). In Russian.

537.226.2

3073. INVESTIGATION OF THE TEMPERATURE DEPENDENCE OF THE TOTAL POLARIZATION, COERCIVE FORCE AND HYSTERESIS LOSSES OF POLYCRYSTALLINE SOLID SOLUTIONS $(Ba,Sr)TiO_3$, $Ba(Ti,Sn)O_3$ AND $Ba(Ti,Zr)O_3$. V.A.Bokov.
Zh. tekh. Fiz., Vol. 28, No. 1, 77-86 (1958). In Russian.

In $Ba(Ti,Sn)O_3$ and $Ba(Ti,Zr)O_3$ spontaneous polarization decreases with decreasing $BaTiO_3$ content. In $(Ba,Sr)TiO_3$ increase of $SrTiO_3$ content to 40% reduces spontaneous polarization; above 50% $SrTiO_3$ spontaneous polarization increases considerably. Coercive force and hysteresis losses of all solid solutions studied decrease on transition from more into less symmetrical phases. Within each phase they increase with falling temperature.
Electrical Research Association

537.226.31 : 621.315.616.9

3074. SOME FEATURES OF THE DIELECTRIC LOSS OF POLYCAPROLACTAM.
G.P.Mikhailov, B.I.Sazhin and N.N.Kupriyanchik.
Zh. tekh. Fiz., Vol. 27, No. 5, 948-52 (1957). In Russian.

Curves are given of loss tangent as a function of temperature for annealed and hardened polycaprolactam (a polyamide) at frequencies of 1, 5, 20, 480 kc/s and 5 Mc/s and at temperatures between 0 and 150°C. The curves for the annealed material show a single maximum which occurs at higher temperatures the higher the frequency. The behaviour of the hardened material is more complex, and at intermediate frequencies there are two maxima in the curves. The bearing of the state of crystallization and of relaxation processes in the material on these results is discussed. R.F.S.Hearmon

537.226.32 : 537.312.5

3075. ON THE THEORY OF PHOTO-ELECTRETS.
V.M.Fridkin, N.T.Kashukeev and I.S.Zheludev.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 5, 804-7 (1957). In Russian.

Space charge is produced in a layer of polycrystalline sulphur in the process of photoconduction. This space charge, producing permanent polarization, may be retained for a long time. The effect was discovered by Nadzhakov (1937) and the substances exhibiting it are called photo-electrets. The present paper deals with the theory of the effect.

537.228 : 536.7

3076. THERMODYNAMICS FOR ELASTIC SOLIDS IN THE ELECTROSTATIC FIELD. I. GENERAL FORMULATION.
J.C.M.Li and Tsuan Wu Ting.
J. chem. Phys., Vol. 27, No. 3, 693-700 (Sept., 1957).

A condensed collection of all the thermodynamic relations among first derivatives for elastic solids under the outside variation of only temperature, stress, and the electrostatic field is presented. Simple relations among all the possible empirical coefficients are tabulated. Tables of first derivatives with respect to variables of practical interest, from which the Jacobians and all other first derivatives can be obtained in terms of empirical quantities, are given and their applications are illustrated with examples. A.

537.228.1

3077. DEPENDENCES OF THE [d_{33}] PIEZOMODULUS OF POLYCRYSTALLINE $BaTiO_3$ ON UNILATERAL PRESSURE.
I.A.Izhak and O.A.Shugurov.
Zh. tekh. Fiz., Vol. 28, No. 3, 518-20 (1958). In Russian.

537.228.2

3078. TWO EXPERIMENTS ON THE ELECTROMECHANICAL BEHAVIOUR OF BARIUM TITANATE CERAMIC IN THE CURIE REGION. G.Schmidt.
Z. Phys., Vol. 148, No. 3, 314-20 (1957). In German.

The thickness deformation of a disk was plotted as a function of field or polarization using a 50 c/s field. A small 400 c/s voltage was then superimposed, and it was found that the small subsidiary deformation loops followed the field without hysteresis, while the slower main deformation did show hysteresis. In the second experiment on pre-polarized ceramic, the deformation due to a high applied field was found to be roughly proportional to the field. It is deduced that in both these cases 180° domain reorientations predominate. K.W.Plessner

537.228.4

3079. A MOLECULAR THEORY OF THE ELECTRO-OPTICAL KERR EFFECT IN LIQUIDS. A.D.Buckingham and R.E.Raab.
J. Chem. Soc., 1957, 2341-51 (May).

The classical statistical-mechanical theory of the electro-optical Kerr constant is extended to include the effects of molecular interactions and of the dependence of molecular polarizabilities on field strength. The resulting formula is simple for molecules without permanent dipole moments, for which it is found that at all densities the molecular Kerr constant is expressible in the form A + B/T, where A and B are constants characteristic of the substance. Experiments suggest that at room temperature A is responsible for about half of the observed Kerr constant of mesitylene. For pure polar liquids, the Kerr constant reduces to an expression involving, inter alia, the static and high-frequency dielectric constants. The final equation depends only on short-range effects, and for the Onsager model of a pure polar liquid leads to a simple result which agrees quite well with experimental data. The general result is applied to water, and Pople's molecular model used to compute the temperature dependence of its Kerr constant. A.

ELECTRIC CONDUCTION. CURRENTS

537.311.1

3080. ON THE DRIFT-VELOCITY METHOD. Yu.N.Obraztsov.
Zh. tekh. Fiz., Vol. 28, No. 2, 245-9 (1958). In Russian.

An apparent divergence of current densities in metals and semiconductors calculated by an exact solution of the kinetic equation and by means of the drift-velocity method (Abstr. 7256/1950) is discussed. The present author disputes Dingle's reasons for this divergence (Abstr. 8182/1956) and shows that correct application of the drift-velocity method produces correct results.

537.311.3 : 537.323 : 621.315.56

3081. ELECTRICAL PROPERTIES OF ARC-EVAPORATED CARBON FILMS. M.D.Blue and G.C.Danielson.
J. appl. Phys., Vol. 28, No. 5, 583-6 (May, 1957).

Uniform thin films of C in the thickness range 100 to 2300 A have been prepared by arc-evaporation in vacuum. Evaporation rates were about 50 A/sec. The electrical properties of these films suggest that unannealed arc-evaporated C had less long-range order and was, therefore, more truly amorphous in structure than any other form of carbon yet obtained. After the films had been heated to 1200°K, however, their properties were similar to ordinary fine-particle carbon blacks, apparently as a result of increased ordering. The electrical resistivity of unannealed films followed Ohm's law, was not photosensitive, and could be well represented in the temperature range from 77° to 300°K by the equation $R = AT^{-b}$, where b = 5. When the C films were heated above room temperature, the resistivity and the exponent b were both decreased substantially. After the films were annealed at 1200°K, the resistivity was reduced by a factor exceeding 800, and could be best represented, in the temperature range 77° to 1200°K, by the equation $R = \alpha - \beta T$. The values of the resistivity, temperature coefficient of resistivity, and thermoelectric power of the annealed films were then more nearly in agreement with the corresponding values for ordinary fine-particle carbon blacks. Other properties and applications of the films are discussed. A.

537.311.31 : 539.2

3082. THE CHANGE OF ELECTRICAL RESISTANCE WITH ELEMENTARY SLIP FORMATION.
E.D.Shchukin, V.N.Rozhanskii and Yu.V.Goryunov.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 6, 1101-3 (1957). In Russian.

Zinc and cadmium single crystals were subjected to tension at 30° to the hexagonal axis, and the change in electrical resistance measured. The results are discussed in terms of dislocation theory (see Abstr. 2863/1954). R.F.S.Hearmon

537.311.31 : 537.312.8

3083. QUANTUM THEORY OF ELECTRICAL CONDUCTIVITY OF METALS IN A MAGNETIC FIELD. I.M.Lifshits.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1509-18 (1957). In Russian.

A consistent quantum-mechanical theory of electrical conductivity of metals in a magnetic field is proposed. The kinetic equation for the statistical operator is derived on some general assumptions regarding the energy spectrum of electrons. The transition to the classical case is analysed. The asymptotic values of the kinetic coefficients in a strong magnetic field are studied. On the basis of relations between the solutions of the quantum and classical equations, quantum corrections to the kinetic coefficients are determined, which include conductivity oscillations. A.

537.311.31 : 537.312.8

3084. ON THE THEORY OF THE SHUBNIKOV–DE HAAS EFFECT. I.M.Lifshits and A.M.Kosevich.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 88-100 (1957). In Russian.

Quantum oscillations of the electrical conductivity ($\sigma^{\alpha\beta}$) and specific resistance ($\rho^{\alpha\beta}$) tensors in metals are investigated on the basis of some earlier general formulae. It is shown that oscillations of $\sigma^{\alpha\beta}$ and $\rho^{\alpha\beta}$ may be expressed in terms of the magnetic moment oscillations in the de Haas–van Alphen effect and in terms of the classical values of the mobility tensor. The asymptotic values of the oscillation amplitudes in strong magnetic fields are investigated and some simple cases are considered for which calculation of the oscillation amplitudes may be carried out completely. A.

537.311.31 : 537.311.62

3085. SURFACE IMPEDANCE OF METALS IN THE INFRARED REGION. M.I.Kaganov and V.V.Slezov.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1496-504 (1957). In Russian.

An expression is obtained for the surface impedance of metals in the infrared region without making any special assumptions concerning the law of dispersion of conduction electrons. A.

537.311.31 : 536.48

3086. ELECTRICAL RESISTANCE OF $CuAu_3$ AND Cu_3Au AT LOW TEMPERATURES. M.Hirabayashi and Y.Mutô.
J. Phys. Soc. Japan, Vol. 12, No. 7, 830-1 (July, 1957).

Measurements are reported of the electrical resistivities of $CuAu_3$, CuAu and Cu_3Au in quenched and annealed states from 2°K to room temperature. Some deviations from the results of Passaglia and Love (Abstr. 6152/1955) are noted. D.M.Edwards

537.311.31

3087. RESISTANCE AND MAGNETO-RESISTANCE OF DILUTE ALLOYS OF GOLD WITH IRON AT LOW TEMPERATURES. A.N.Gerritsen.
Physica, Vol. 23, No. 12, 1087-99 (Dec., 1957).

The determination of resistance and magnetoresistance as a function of temperature, magnetic field, and concentration of two series of dilute gold–iron alloys, has not confirmed without doubt the existence of a maximum in the resistance–temperature curve. Besides the existence of a possible flat maximum, there is a change in resistance which suggests a magnetic transition for temperatures below this maximum. Apart from a region of small concentration values (0.02 to 0.15 at. %) where the temperature of the transition depends on the concentration, the effect is not dependent on the concentration for the range 0.15 to 1.23 at. % iron. As a possible explanation, it is suggested that this transition is a property of the gold, made observable by a minimal value of an internal magnetic field due to the iron. The magnetoresistance shows dependence on field, concentration, and temperature, similar to that found for the case of alloys with other transition metals. A.

537.311.32 : 621.315.57

3088. ELECTRICAL CONDUCTIVITY OF FUSED QUARTZ. J.Cohen.
J. appl. Phys., Vol. 28, No. 7, 795-800 (July, 1957).

The electrical conductivities of two specimens of clear fused quartz were measured in vacuo in the temperature range from 600° to 1400°C. The method of potential probes was used to evaluate the Pt contacts and eliminate effects of high contact resistance. One specimen obeyed Ohm's law, as evidenced by the linear dependence of the current on the potential between probes and the uniform potential distribution. This behaviour established the specimen as an electronic conductor. The value of specific conductivity was $\sim 10^{-4}$ mho/cm over the interval from 1000° to 1400°C. Ohm's law was not found applicable for the other specimen, which displayed many dielectric anomalies and polarization effects such as polarization voltages, anomalous potential distributions, reverse currents, and current decays immediately after application of a voltage. The phenomena indicated the presence of space-charge polarization, and here the conductivity appeared to be substantially ionic. Heat treatment of this specimen stabilized the electrical behaviour and caused increased or decreased resistance, depending on voltage, polarity and temperature of measurement. The heating was also found to produce partial crystallization. It is suspected that the marked contrasts in the behaviour of the two specimens are due to differences in the impurity contents. A.

537.311.32

3089. ELECTRICAL CONDUCTIVITY OF PLEXIGLAS. R.J.Munick.
J. appl. Phys., Vol. 28, No. 11, 1302-3 (Nov., 1957).

The electrical conductivity of Plexiglas in an electric field of 2.6 kV/cm in the temperature range from 21° to 90°C was found to be represented by the sum of two exponentials, which have activition energies of 1.45 and 2.7 eV. At the higher temperatures curves of current as a function of electric field strength from 2.6 to 29 kV/cm were resolved into the sum of a linear and an exponential term. The results suggest that ionic conduction dominates at low fields. A.

537.311.32 : 539.893

3090. LACK OF METALLIC TRANSITION IN LiH AND $LiAlH_4$ UNDER STATIC PRESSURE. D.T.Griggs, W.G.McMillan, E.D.Michael and C.P.Nash.
Phys. Rev., Vol. 109, No. 5, 1858-9 (March 1, 1958).

Previous experiments (Abstr. 2832/1957) indicated increases in the electrical conductivity of $LiAlH_4$ and of several alkali halides by factors $\sim 10^6$ under shock pressures $\sim 10^5$ b. However, measurements in a Bridgman apparatus showed no onset of metallic conductivity (a) in LiH up to 240 kb at room temperature, (b) in $LiAlH_4$ up to 200 kb at room temperature, nor (c) in $LiAlH_4$ at 70 kb at temperatures up to 350°C. A.B.Lidiard

537.311.32 : 539.374

3091. THE INFLUENCE OF PLASTIC DEFORMATION ON THE ELECTRICAL CONDUCTIVITY OF SINGLE CRYSTALS OF POTASSIUM CHLORIDE WITH SUBSTITUTED CALCIUM CHLORIDE. J.Burmeister.
Z. Phys., Vol. 148, No. 3, 402-16 (1957). In German.

The effects were investigated for $CaCl_2$ substitution up to about 1%, and in the temperature range 230° to 350°C. Two different effects were observed, depending on the precise temperature interval. The first is a conductivity increase proportional to the initial deformation, and explicable in terms of Mott's theory of hardening. The other is an increase depending on the deforming force resulting from motion of vacancies and Ca ions. C.A.Hogarth

537.311.33

3092. MOBILITY OF ELECTRONS AND HOLES IN A LIQUID SEMICONDUCTOR. I.Z.Fisher.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 3, 399-402 (1957). In Russian.

537.311.33 : 621.315.59

3093. ON THE STATISTICAL MECHANICS OF IMPURITY CONDUCTION IN SEMICONDUCTORS. P.J.Price.
I.B.M. J. Res. Developm., Vol. 2, No. 2, 123-9 (April, 1958).

The statistical mechanics of the impurity electron states for a semiconductor with a low density of donors, and a small amount of acceptor compensation, is analysed. Expressions are obtained for the number of dissociated donor ion states according to the Mott model, and for the effects of multiple trapping, and of dispersion of the trapping energies, on this number. An expression for the thermoelectric power according to the Mott model is obtained. If a small proportion of "minority" donors, of a different chemical species with a smaller electron binding energy than the majority donors, were added to the impurity content they should act as additional traps for donor ion states: the statistical mechanics of this system is analysed. A.

537.311.33 : 538.632 : 538.74

3094. THE HALL-EFFECT COMPASS. I.M.Ross, E.W.Saker and N.A.C.Thompson.
J. sci. Instrum., Vol. 34, No. 12, 479-84 (Dec., 1957).

Recent work on semiconductors has led to materials in which the Hall effect in the earth's magnetic field is strong enough to form the basis of a simple electrical compass. The theory of the device is briefly presented and expressions derived for the voltage and power output, and the ultimate sensitivity obtainable. The comparative merits of various semiconductors are shown in tabular form; this information should be useful also for other devices based on the Hall effect. An experimental compass unit is described, which had a power output of 6×10^{-9} W/deg. of arc. Various possible systems using such a unit are briefly discussed, including the use of supergeneration for increasing the power available. A.

537.311.33

3095. ON THE MASS-ACTION LAWS IN DEGENERATE SEMICONDUCTORS. F.W.G.Rose.
Proc. Phys. Soc., Vol. 71, Pt 4, 699-701 (April, 1958).

The effective density of energy levels in the conduction and valence bands may be defined even when the semiconductor is degenerate. Relations are given showing how the degenerate case may be derived from the non-degenerate one, using the mass-action laws. An example is given of the calculation of hole lifetime in a degenerate n-type semiconductor with acceptor traps. C.Hilsum

537.311.33

3096. THE INFLUENCE OF INTERELECTRONIC COLLISIONS ON CONDUCTION AND BREAKDOWN IN COVALENT SEMICONDUCTORS. R.Stratton.
Proc. Roy. Soc. A, Vol. 242, 355-73 (Nov. 5, 1957).

The energy and momentum distributions of electrons (or holes) in high electric fields are largely determined by interelectronic collisions if the electron densities are sufficiently high; but at lower densities only the energy distribution is affected. These distributions are used to evaluate the field for which a steady state becomes impossible (breakdown), and to calculate the variation of the mobility (μ) with the applied field (F). Approximate results, obtained by

neglecting interelectronic collisions entirely are also presented. However, it is shown that the latter calculations are really invalid since electrons which, by a fluctuation, achieve energies exceeding a certain critical energy, of order 1 eV, will increase their energy indefinitely under the action of the field. Both acoustic and optical lattice mode scattering are considered for various temperature ranges. Beside the well-established proportionality of μ to $F^{-1/2}$ and to F^{-1} at high temperatures there are regions of field strengths at low temperatures where μ varies as $F^{-4/5}$ and $F^{-4/3}$, respectively. A.

537.311.33 : 537.312.5

3097. GENERATION OF AN E.M.F. IN SEMICONDUCTORS WITH NONEQUILIBRIUM CURRENT CARRIER CONCENTRATIONS. J.Tauc.
Rev. mod. Phys., Vol. 29, No. 3, 308-24 (July, 1957).

Detailed considerations of the development of photovoltaic effects in semiconductors, arising from inhomogeneities in the distribution of charge carriers. The barrier layer photocell, the Dember effect, the photomagnetoelectric effect, and other means of producing e.m.f.'s from non-euqilibrium conditions within the specimen are also discussed. C.A.Hogarth

537.311.33

3098. DECAY LAW FOR CONCENTRATION OF NON-EQUILIBRIUM CHARGE CARRIERS IN SEMICONDUCTORS. G.M.Guro.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 158-65 (1957). In Russian.

Decay processes of non-equilibrium carriers uniformly generated throughout the volume of a semiconductor are considered. The law of decay of the concentration of non-equilibrium carriers in a semiconductor containing a small concentration of recombination centres (traps) is derived for arbitrary deviations from thermodynamical equilibrium. Approximate expressions of this law are obtained for various intervals of variation of the concentration of non-equilibrium carriers. The expressions correspond to various kinetic modes of recombination. It is shown that along with such well-known modes as the monomolecular and bimolecular, a steady rate of recombination can also take place, the corresponding lifetime being proportional to the concentration of the non-equilibrium carriers. This occurs at low temperatures in semiconductors for which the recombination cross-section of the minority carriers is much larger than that for the majority carriers. A.

537.311.33 : 536.73

3099. THERMODYNAMIC TREATMENT OF ELECTRONIC PROCESSES IN SEMICONDUCTOR SURFACE LAYERS. H.A.Müser.
Z. Phys., Vol. 148, No. 3, 380-90 (1957). In German.

The perturbed electron and hole concentrations, produced when the thermodynamic equilibrium is disturbed, are related to a "distribution temperature". The rectifier characteristic and photoelectric efficiency of a p–n junction are derived by assuming that the second law of thermodynamics is applicable to the distribution temperature. R.Stratton

537.311.33

3100. ON ELECTRICAL CONDUCTIVITY OF AMORPHOUS SEMICONDUCTORS. G.V.Gordeev.
Zh. tekh. Fiz., Vol. 28, No. 3, 539-41 (1958). In Russian.

Extension of Gubanov's band theory of amorphous semiconductors (Abstr. 8087/1954, 8541/1955, 8038/1956, 1955/1957). This theory is given a multielectron basis using the method of elementary excitations (quasiparticles).

537.311.33 : 621.317.6

3101. DIRECT READING MINORITY CARRIER LIFETIME MEASURING APPARATUS. A.R.Engler and C.J.Kevane.
Rev. sci. Instrum., Vol. 28, No. 7, 548-51 (July, 1957).

Minority carrier lifetimes greater than 10 μsec can be measured. The decay of optically injected excess minority carriers is compared with voltage decay in an RC circuit, and lifetimes are read directly from a calibrated dial. Measurements can be made quickly without critical adjustment. An alignment chart is included for rapid calculation of surface recombination velocity from lifetime data. A.

537.311.33 : 669.054

3102. ZONE MELTING AND CRYSTAL PULLING EXPERIMENTS WITH AlSb. W.P.Allred, B.Paris and M.Genser.
J. Electrochem. Soc., Vol. 105, No. 2, 93-6 (Feb., 1958).

It was found that high-resistivity AlSb ingots result from the zone refining of the compound in Al_2O_3 crucibles. Distribution coefficients of the spectroscopically observed impurities in AlSb were found to be 0.1 and smaller. Resistivity and Hall coefficients were determined for some single-crystal specimens cut from the zone-melted ingots. Single crystals of AlsB were grown by pulling from the melt. These crystals exhibited low resistivities. The mobility for holes in the crystals was found to range between 300 and 500 $cm^2\ V^{-1}\ sec^{-1}$. A.

537.311.33 : 538.63

3103. OSCILLATORY GALVANOMAGNETIC PROPERTIES OF BISMUTH SINGLE CRYSTALS IN LONGITUDINAL MAGNETIC FIELDS. J.Babiskin.
Phys. Rev., Vol. 107, No. 4, 981-92 (Aug. 15, 1957).

The galvanomagnetic effects of oriented single crystals of Bi were studied in longitudinal magnetic fields up to 60 000 G at liquid He temperatures. Oscillatory behaviours with de Haas-van Alphen periodicity were discovered to be superimposed upon the normal galvanomagnetic effects. These results showed that the periods for galvanomagnetic oscillations were independent of the direction and magnitude of the electric current. At high fields, a previously unreported oscillation was observed having a period which compares favourably with the period calculated from parameters for the de de Haas-van Alphen effect at the same orientation. At the higher fields and lower temperatures, the galvanomagnetic oscillations exhibited a remarkable resemblance to the exact theory for the oscillatory magnetic susceptibility of a free-electron gas. Both the normal and the oscillatory galvanomagnetic effects are analysed in terms of a tilted, multi-ellipsoidal model. For one of the orientations studied, the normal longitudinal magnetoresistance exhibited an anomalous maximum, which is attributed to scattering from internal surfaces. A.

537.311.33 : 536.21

ELECTRICAL RESISTIVITY OF BISMUTH AND ANTIMONY AT LOW TEMPERATURES. See Abstr. 3019

537.311.33 : 538.66

3104. THE "DRAG" EFFECT IN THE THERMOMAGNETIC PROPERTIES OF BISMUTH SELENIDE. Kh.I.Amirkhanov, R.I.Bashirov, A.Z.Daibov, and I.M.Tsidil'kovskii.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 5, 781-4 (1957). In Russian.

Measurements have been made of the Hall, thermoelectric and transverse and longitudinal Nernst–Ettinghausen effects for ten samples of polycrystalline Bi_2Se_3, and the results are given graphically over a temperature range of 100-700° K. S.F.Edwards

537.311.33

3105. ON THE CONDUCTION MECHANISM IN THE SYSTEM Cu-Te. G.Harbeke.
Abhandl. Braunschw. Wiss. Gesell., Vol. 9, 180-8 (1957). In German.

Measurements of the electrical conductivity and Hall effect showed that bulk samples of Cu_2Te were quasi-metallic conductors, whereas the similar compound Ag_2Te is a semi-conductor. However, the conductivity-temperature curve, for very thin evaporated layers, indicated the presence (confirmed by optical absorption measurements) of a semiconducting phase in the Cu–Te system and gave activation energies of 0.04 eV (below 100°C) and 1.12 eV (above 100°C). The existence of several phase transitions, for the bulk samples, was deduced from irregularities in the conductivity-temperature curves. R.Stratton

537.311.33

3106. INFLUENCE OF ELECTRIC FIELD IN DIFFUSION REGION UPON BREAKDOWN IN GERMANIUM N–P JUNCTIONS. E.M.Pell.
J. appl. Phys., Vol. 28, No. 4, 459-66 (April, 1957).

The high current density existing at near-breakdown reverse-bias of an n–p junction produces, by Ohm's Law, an electric field. If the effect of this field is included in the solution for diode current, it is found that it can significantly affect the breakdown characteristic. It can, for example, produce an increase in injected photocurrent resembling multiplication, even though multiplication is not occurring in the junction itself. Alternatively, if multiplication is present, it can produce instability and breakdown before the avalanche in the space-charge region itself becomes unstable (i.e. before the multiplication factor becomes infinite). These predicted phenomena were observed in a series of Ge n–p junctions. Closely allied with these phenomena is the observation of a region of "soft breakdown" in many Ge junctions, which appears to be a bulk effect. A.

537.311.33 : 538.632

3107. MEASUREMENT OF THE HALL MOBILITY IN N-TYPE GERMANIUM AT 9121 MEGACYCLES. Y.Nishina and W.J.Spry.
J. appl. Phys., Vol. 29, No. 2, 230-1 (Feb., 1958).

A cavity technique was used, and a value of 2900 $cm^2\ V^{-1}sec^{-1}$ obtained for the microwave mobility of 16 ohm cm n-type Ge. This is compared with the d.c. value of 2670 $cm^2\ V^{-1}sec^{-1}$. C.A.Hogarth

537.311.33

3108. THE SURFACE CHEMISTRY OF GERMANIUM. I. CHEMICAL EFFECTS AT PN JUNCTIONS.
J.I.Carasso and I.Stelzer.
J. Chem. Soc., 1956, 3726-32 (Oct.).

Deviations in the current-voltage characteristics of reverse-biased Ge p-n junction diodes exposed to various environments are summarized. Further observations are reported which suggest a mechanism correlating the electrical effects of the gas on the diode with its chemical properties. The electron affinity (or ionization potential) of the adsorbate and the work function of the Ge are related to the equilibrium conditions occurring at the surface. A.

537.311.33 : 534.39

3109. ACOUSTOELECTRIC EFFECT IN N-TYPE GERMANIUM.
W.Sasaki and E.Yoshida.
J. Phys. Soc. Japan, Vol. 12, No. 8, 979 (Aug., 1957).

Measurements showed that the acousto-electric field induced by the movement of majority carriers was proportional to the acoustic-energy flow-density, with a constant of proportionality of about 1.3×10^{-7} V cm^{-1}/(W cm^{-2}), for fields in the range 10^{-7} to 3×10^{-6} V/cm. The constant was independent of acoustic frequencies in the range from 26.5 to 80 kc/s. R.Stratton

537.311.33

3110. RADIAL VARIATION OF MINORITY CARRIER LIFETIME IN VACUUM-GROWN GERMANIUM SINGLE CRYSTALS.
C.A.Hogarth and P.J.Hoyland.
J. Electronics and Control, Vol. 4, No. 1, 60-2 (Jan., 1958).

It is shown that the minority carrier lifetime decreases radially from the centre of vacuum-grown crystals, but does not for crystals grown in argon. Two possible explanations are advanced to explain this. C.A.Hogarth

537.311.33 : 537.312.5

3111. RECOMBINATION CENTERS AND FAST STATES ON UNSTABLE GERMANIUM SURFACES. S.Wang and G.Wallis.
Phys. Rev., Vol. 107, No. 4, 947-53 (Aug. 15, 1957).

Measurements of surface conductance, photoconductance, dark field effect, and field effect under illumination were made on single crystals of n-type and p-type Ge. The samples, freshly etched with CP-4, were exposed to the Brattain–Bardeen ambient cycles (Abstr. 1637/1953). During early cycles, the measurements were irreproducible. The irreproducibility was due to changes in the density of the dominant surface recombination centres. The density of these centres varied by an order of magnitude during the ambient cycle, whereas the energy levels and the capture probabilities remained constant. With these assumptions, quantitative agreement between theory and experiment was obtained. From the changes in the photoconductance and the dark-field effect during repeated ambient cycles, the density of the dominant recombination centres was found to change at the same rate as the density of the "fast" states near the centre of the gap. In addition, the recombination centres and the "fast" states have the same energy levels. Therefore, the recombination centres and "fast" states are identical. A.

537.311.33 : 537.312.5

3112. COPPER-DOPED GERMANIUM AS A MODEL FOR HIGH-RESISTIVITY PHOTOCONDUCTORS. P.J.van Heerden.
Phys. Rev., Vol. 108, No. 2, 230-8 (Oct. 15, 1957).

In the electrical behaviour of high-resistivity Cu-doped Ge the nature of the electrodes plays an essential role. Three different types of space-charge contact can be distinguished. For two types of contact only primary photocurrents are observed, for the other both primary and secondary photocurrents. The secondary photocurrent is observed only in samples with the electrodes prepared in such a way that they show the space-charge-limited current. A simple theory on the magnitude of the secondary photocurrent was confirmed experimentally. Also, some observations are given on the space-charge-limited current, together with some experiments which throw light on the mechanism of electrical breakdown in this material. A.

537.311.33 : 538.63

3113. EFFECT OF IMPURITY SCATTERING ON THE MAGNETO-RESISTANCE OF N-TYPE GERMANIUM. M.Glicksman.
Phys. Rev., Vol. 108, No. 2, 264-7 (Oct. 15, 1957).

Observations in n-type Ge show a decrease in the anisotropy of the magnetoresistance with increased ionized-impurity content and with decreased temperature. Although similar to what is expected due to ionized-impurity scattering, the details of the variation do not agree with calculations assuming anisotropic impurity scattering. Deviations from the magnetoresistance symmetry conditions are observed for crystals with electron concentration $> 4 \times 10^{15}$ cm^{-3} at 77°K. A.

537.311.33 : 538.63

3114. GALVANOMAGNETIC EFFECTS IN ORIENTED SINGLE CRYSTALS OF N-TYPE GERMANIUM. W.M.Bullis.
Phys. Rev., Vol. 109, No. 2, 292-301 (Jan. 15, 1958).

Measurements of the magnetoresistance, Hall, and planar Hall coefficients were made on oriented single crystals of n-type Ge at 77° and 300°K. At 77°K measurements made as a function of the magnetic field strength, and of the angle between the current and the magnetic field were found to be in agreement with theoretical calculations based on an energy-independent mean free time τ_0, which has the same form of anisotropy as the effective mass at the bottom of the conduction band. The value of τ_0 is determined from previously described Hall measurements (Abstr. 2102/1956) and the anisotropy factor K is determined from the high-field longitudinal magneto-resistance. K decreases from about 16 to about 12 as the electron density increases from about 5.4×10^{13} cm^{-3} to about 5.2×10^{14} cm^{-3}. At 300°K measurements were made for selected orientations of current and field on samples whose resistivities varied from 0.016 to 8.9 ohm.cm. The usual low-field symmetry relations are satisfied. Most of the low-field coefficients may be satisfactorily interpreted by means of relatively simple functional relationships between the mean free time τ and the energy $\mathcal{E}$. Although the field dependence of the Hall coefficient cannot be quantitatively explained in this manner, the qualitative features of the various Hall curves may be understood. Above 0.1 ohm.cm, K is found to be about 17.3, independent of the relationship between τ and $\mathcal{E}$. Below 0.1 ohm.cm, K falls off, reaching about 14 at 0.016 ohm.cm. The decrease in the value of K as the temperature is lowered or as the impurity concentration is increased is attributed to an increase in the scattering anisotropy as impurity scattering becomes more important. With the assumption that the mass anisotropy is constant with temperature and impurity density, the magnitude of the scattering anisotropy can be computed. A.

537.311.33

3115. THE FERMI LEVEL IN GERMANIUM AT HIGH TEMPERATURES. J.S.Blakemore.
Proc. Phys. Soc., Vol. 71, Pt 4, 692-4 (April, 1958).

Curves are given showing how the position of the Fermi level varies with temperature from 300°K to 1200°K, for several donor and acceptor concentrations between the limits 10^{16} and 10^{20} cm^{-3}. The calculations allow for the variation of the energy gap with temperature. C.Hilsum

537.311.33 : 537.312.5

3116. THE EFFECT OF SURFACE RECOMBINATION ON THE SPECTRAL RESPONSE OF PHOTOCONDUCTIVITY OF N-TYPE GERMANIUM. Tang Ting-Yuan and Kao Kuo-Yu.
Scientia Sinica, Vol. 7, No. 2, 165-78 (Feb., 1958).

The continuity equation of minority carriers in n-type germanium is solved for the steady-state case, in which the volume recombination is assumed to be of the Shockley–Read type and the surface recombination velocity is introduced in the boundary condition. An expression for the photoconductivity is formulated from this solution. By introducing the known optical absorption data and the measured value of volume lifetime of minority carriers into the expression of photoconductivity and by choosing suitable value of surface recombination velocity, theoretical photoconductive spectra are calculated and are compared with the experimental curves presented in this paper. The agreement is satisfactory for wavelengths greater than 1.2 μ. Below 1.2 μ, the experimental curve falls well below the calculated curve. It is thought that other types of volume recombination may exist. From the result of this analysis, a simple means of determining the energy gaps of germanium is derived, values of 0.83 eV for direct transition and 0.635 eV for indirect transition across the forbidden band of germanium are obtained. Analysis of the shape of spectral photo-response curves under different surface conditions also provides means for determining the surface recombination velocities. This analysis is suitable in the cases of medium and high values of surface recombination velocities. A.

537.311.33 : 538.63

3117. MAGNETORESISTIVE EFFECTS IN N-Ge TYPE SEMICONDUCTORS LOCATED IN STRONG MAGNETIC FIELDS.
M.I.Klinger and P.I.Voronyuk.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 77-87 (1957). In Russian.

The equilibrium electron concentration, Hall constant, and electrical resistance of n-Ge type semiconductors located in a

strong magnetic field are considered. The dependence of these quantities on the field strength is determined. It is found that the quantities under consideration are anisotropic, the nature of this anisotropy being determined by anisotropy of the electron mass and by the number and mutual arrangement of the constant energy ellipsoids. A.

537.311.33

3118. THE EFFECT OF ANNEALING ON THE LOCAL ENERGY LEVELS AND THE LIFETIME OF THE NON-EQUILIBRIUM CURRENT CARRIERS IN IRON-DOPED GERMANIUM.
K.D.Glinchuk, F.G.Miselyuk and N.N.Fortunatova.
Zh. tekh. Fiz., Vol. 27, No. 11, 2666-7 (1957). In Russian.

Lifetime (τ) of the current carriers in Ge specimens of $\cong$ 0.02-50 Ω. cm resistivity, and with the Fe-centre concentration $< 10^{14}cm^{-3}$, was measured before and after annealing at 470°C for 24 hours. It was shown that annealing resulted in (a) deactivation of the acceptor levels with the activation energy of 0.27 eV, (b) increase of the concentration of the current carriers, and (c) increase of τ by a factor of over 100 in some cases. The cross-section for capture of holes on the acceptor levels, situated at 0.27 eV from the lower edge of the conduction band and at 0.34 eV from the valence band, was determined and found to be $\cong 1.0 \times 10^{-14}cm^2$ and $3.0 \times 10^{-15}cm^2$ respectively. M.H.Sloboda

537.311.33 : 538.632 : 539.234

3119. PREPARATION AND VARIOUS ELECTRICAL PROPERTIES OF THIN FILMS OF InSb. C.Paparoditis.
C.R. Acad. Sci. (Paris), Vol. 245, No. 18, 1526-8 (Oct. 28, 1957). In French.

These were formed on mica substrates by evaporation in high vacuum, and annealed in argon atmospheres at various temperatures. Highest resistivity and Hall coefficient were achieved for annealing temperatures between 230° and 280°C, such films showing true semiconductor characteristics, with electron carrier concentrations of 2×10^{17} cm^{-3}. X-ray measurements on these films showed no free In or Sb, although these were present in films annealed at other temperatures. Crystallites of size about 400 A were indicated by the electron microscope, and mean free paths for carriers were estimated to be of the order of 30 Ag much less than for bulk specimens. D.Haneman

537.311.33 : 537.312.5

3120. THE EFFECT OF VARIOUS GASES AND VAPOURS ON THE SEMICONDUCTING PROPERTIES OF EVAPORATED LEAD SELENIDE LAYERS. H.Gobrecht, F.Niemeck and K.E.Boeters.
Z. Phys., Vol. 148, No. 3, 281-97 (1957). In German.

With increasing partial pressure of Hg vapour the photosensitivity decreased while the dark resistance passed through a maximum. A quantitative theory, based on the diffusion of Hg atoms (which produced donors) in the originally p-type layer, gave good agreement. With increasing pressure of permanent gases (air, hydrogen, oxygen, nitrogen and argon) the photosensitivity again decreased, but the dark resistance was unaffected. The results were interpreted by assuming that polarized, adsorbed surface-layers were produced, thus affecting the distribution of charge carriers in the surface region. R.Stratton

537.311.33

3121. HEAT TREATMENT OF SILICON USING ZONE HEATING TECHNIQUES. H.C.Theuerer, J.M.Whelan, H.E.Bridgers and E.Buehler.
J. Electrochem. Soc., Vol. 104, No. 12, 721-3 (Dec., 1957).

New insight into the mechanism for the changes in Si with solid-state heat treatment was obtained with the aid of the floating zone apparatus normally used to refine Si. With this system, a liquid or solid hot-zone may be caused to traverse the rod while the rest of the apparatus is kept relatively cool. Through the use of this technique, it has been established that contaminants left on the Si surface, even after careful etching and washing procedures, are a controlling factor in the observed heat-treating effects. The impurities involved have high diffusivities, as is the case for Cu and Fe in Si. That these impurities lower lifetime on heat treatment was demonstrated by rubbing the Si rod with Cu or Fe wires prior to zone heat-treatment. A.

537.311.33 : 535.343

3122. INFRARED ABSORPTION IN N-TYPE SILICON.
W.Spitzer and H.Y.Fan.
Phys. Rev., Vol. 108, No. 2, 268-71 (Oct. 15, 1957).

The absorption by free carriers in n-type Si was studied in a spectral region from 1 to 45 μ for samples of various impurity and carrier concentrations. In all samples measured the absorption consisted of a band between 1.5 and 5 μ, in addition to an absorption that rose smoothly with wavelength. The absorption band was found to be proportional to the carrier concentration in samples doped with different donor impurities. It is suggested that the band is associated with the excitation of carriers to a higher lying energy band. The behaviour of the smoothly rising portion of the absorption curve is in agreement with Fan and Fröhlich theory of free-carrier absorption (Abstr. 7882/1951). Quantitative agreement is obtained with a value of 0.3 m for the effective mass. A.

537.311.33 : 538.632

3123. HALL EFFECT STUDIES OF DOPED ZINC OXIDE SINGLE CRYSTALS. A.R.Hutson.
Phys. Rev., Vol. 108, No. 2, 222-30 (Oct. 15, 1957).

Measurements of the Hall coefficient and the electrical conductivity of single-crystal specimens of n-type ZnO at temperatures between 55° and 300°K are reported. An analysis of carrier concentration v. temperature indicates that "as-grown" crystals contain more than one active donor. Crystals with low initial donor concentrations were doped with H or interstitial Zn or Li, allowing a single-donor-level analysis. Doping was accomplished by interstitial diffusion followed by a rapid quench. Each of the added donors gives rise to a hydrogen-atom-model donor centre whose ionization energy is $E_D = 0.051$ eV for $N_D < 5 \times 10^{16}$ cm^{-3}. Lithium was also found to introduce a small concentration of acceptors, presumably due to an exchange between interstitial and substitutional positions. The quantity $(m^{(N)}/m)^{\frac{3}{2}}D^{-1}$, where $m^{(N)}$ = "density-of-states" effective mass and D = donor degeneracy, was found to be about 0.19 for all three donors, indicating that if D = 2 then $m^{(N)} = 0.5$. The low-frequency dielectric constant of ZnO was redetermined as $\kappa = 8.5$. The effective mass associated with the electron found in a hydrogen-like orbit is then $m^{(H)} = 0.27$ m, and the observed decrease of E_D with increasing N_D corresponds to the overlap of these large orbits. The Hall mobility is 180 cm^2V^{-1}/sec^{-1} at 300°K and increases with decreasing temperature. It was analysed for lattice and impurity scattering. The optical-mode scattering mobility was calculated from both the perturbation and intermediate-coupling theories making use of the effective mass, $m^{(H)}$, so that no adjustable parameters were included. The two theories agree for ZnO, since it turns out to have a polar-mode electron coupling constant of $\alpha = 1$. The mobility so obtained is in good agreement with experimental results and indicates that optical-mode scattering is important above 200°K. Some acoustical-mode scattering also appears to be present. At low temperatures the mobility appears to be limited by impurity scattering. A.

537.311.33 : 539.27 : 621.382

3124. APPLICATION OF THE ELECTRON SHADOW MICROSCOPE TECHNIQUE TO THE STUDY OF THE DISTRIBUTION OF POTENTIAL IN P–N JUNCTIONS.
V.N.Vertsner and L.N.Malakhov.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 2, 266-8 (1958). In Russian.

The electron-optical "schlieren" method developed by Marton and Lachenbruch (Abstr. 2566/1950) was applied to the determination of the potential distribution in p–n junctions. The method consists in stopping out a focused beam of electrons by means of a small stop. Potential differences in the specimen deflect the electrons which then form a shadow image on a fluorescent screen. From the shadow pattern it is possible to deduce the nature of the potential distribution in the p–n junction. T.Mulvey

537.311.33 : 621.316.5 : 621.382

3125. HIGH-SPEED MICROWAVE SWITCHING OF SEMICONDUCTORS. R.V.Garver, E.G.Spencer and R.C.LeCraw.
J. appl. Phys., Vol. 28, No. 11, 1336-8 (Nov., 1957).

A high-speed microwave semiconductor switch, employing an n-type Ge diode (see Abstr. 3334B/1957; Proc. Inst. Radio Engrs, Vol. 44, No. 12, 1875, Dec., 1956) was investigated to determine the ultimate switching speed. Data are presented which show that pulse rise- and decay-times are as fast as 3 mμsec. This limit is imposed by the capacitances and inductances of the equipment and is not intrinsic to the Ge diode. The ultimate rise- and decay-times are determined by relaxation processes in the Ge, and are expected to be faster than 1 mμsec. Two switching pulses of variable spacing in time were employed to show that there are no essential residual processes in the Ge following the application of a pulse. Since there is then no measured dead-time of switching, the pulse-repetition rate is limited by the rise-times and decay-times. Measurements were made on a series of semiconductor switches using different concentrations of donors. As the concentration is decreased, avalanche breakdown occurs at higher negative voltages, which allows

switching of higher microwave powers. Successful operation was obtained with microwave powers as high as 1 W impinging upon the semiconductor switch. In general, rise- and decay-times tend to increase as donors decrease. Thus, rise-times and decay-times of 10 mμsec were obtained at 1 W of microwave power. A.

537.311.33 : 621.382

3126. ON A CERTAIN PROBLEM OF TEMPERATURE DISTRIBUTION OF INTEREST IN TRANSISTOR JUNCTION THEORY. A. Pignedoli.
R.C. Accad. Naz. Lincei, Vol. 23, No. 5, 257-62 (Nov., 1957). In Italian.

In transistor theory a "junction" is defined as any surface of discontinuity of physical (electrical and thermal) properties. Such a discontinuity is usually, but not necessarily, associated with change in chemical composition; a temperature gradient could in principle have the same effect. The present paper investigates mathematically the conditions of thermal and electrical conductivity and of geometrical configuration under which a harmonically varying temperature gradient can produce a transistor effect. J.W.Gardner

537.311.33 : 621.382

3127. CALCULATION OF THE DEPENDENCE OF CURRENT AMPLIFICATION FACTOR ON EMITTER CURRENT IN GERMANIUM ALLOY TRANSISTORS FOR INJECTION AND EXTRACTION AT HIGH TEMPERATURES. L.L.Makovskiĭ.
Zh. tekh. Fiz., Vol. 28, No. 1, 52-4 (1958). In Russian.

It was shown experimentally that in germanium transistors, the current amplification factor depends differently on emitter current for room and elevated temperatures (of the order of 90°C). The method of connecting the triode also affects the dependence of current amplification factor on emitter current. The present article gives a theoretical interpretation of these experimental results.

537.311.4

3128. CONTACT PHENOMENA IN ALKALI-HALIDE CRYSTALS AT HIGH TEMPERATURES. M.S.Kosman and V.F.Pisarenko.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 4, 693-5 (1957). In Russian.

A d.c. field of 50 to 400 V/cm was applied to single-crystal specimens of NaCl, KCl, KBr and KI, with Al foil electrodes, held on by spring clips. Three parameters were measured as a function of time in the temperature range 450° to 600°C: the forward and reverse currents and the open circuit p.d. between the terminals. The latter two increased rapidly to a steady value, whilst the forward current dropped initially and remained constant for several minutes (phase 1), then rose to a different steady value (phase 2), F-centre coloration being observed in phase 2. The duration of phase 1 varied with contact efficiency and applied field. In the absorption spectrum of the thin cathode layer two or three weak bands were observed which coincided with the V_2, V_3, V_4 and V_7 bands. A possible mechanism, showing how V-centres can be created, is suggested to account for the data. J.B.Arthur

537.311.62 : 535.393

3129. THE ANOMALOUS SKIN EFFECT AND THE INFRA-RED PROPERTIES OF SILVER AND ALUMINIUM. J.R.Beattie.
Physica, Vol. 23, No. 9, 898-902 (Sept., 1957).

The interpretation of the optical constants of metals in the near infrared is briefly reviewed. Dingle's dispersion formulae for this part of the spectrum are given in a simple form, and used to analyse some results for silver and aluminium films. The conductivity of the films, measured with direct current, is used in the analysis. Agreement is obtained to second-order accuracy in the case of silver. There is one free electron per silver atom, and a fraction 0.77 of the conduction electrons were diffusely reflected at the surface of the metal. For aluminium, the dispersion curve deviates from Dingle's theory for $\lambda < 5\mu$. For $\lambda > 5\mu$ exact numerical agreement cannot be obtained. It is thought that these discrepancies are due to the influence of the band structure of aluminium. A.

537.312.5

3130. SPONTANEOUS APPEARANCE AT LOW TEMPERATURES OF AN ELECTROMOTIVE FORCE IN SELENIUM PHOTOCELLS. G.Blet.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 2044-7 (Dec. 4, 1957). In French.

On cooling a Se photocell, a potential developed in the opposite sense to the photo e.m.f., and exceeded 1 V at 100°K. The potential disappeared during irradiation at a wavelength of 0.75 μ with an energy of 10^{-5} erg. J.Franks

537.312.5

3131. OBSERVATION OF PHOTOVOLTAIC EFFECTS WITH THIN LAYERS OF CADMIUM SULPHIDE. F.Cabannes.
C.R. Acad. Sci. (Paris), Vol. 246, No. 2, 257-60 (Jan. 13, 1958). In French.

Photocells were made by evaporating CdS on to a copper support and then applying a grid-shaped indium electrode. Their resistance was extremely high until a voltage greater then ½ volt was applied. Then the resistance dropped by a factor of 1000 and weak photovoltaic effects could be observed. Cells were also made with an intermediate copper or silver electrode evaporated on to the support before the CdS. They had low resistance, and developed weak photovoltaic sensitivity after being left for two months. C.Hilsum

537.312.5 : 537.226.32 : 771.535

3132. PHOTO-ELECTRETS AND THE FORMATION OF THE LATENT ELECTROPHOTOGRAPHIC IMAGE. V.M.Fridkin.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 2, 273-6 (1958). In Russian.

Photo-electrets are made from certain insulators by simultaneous exposure to light and an electric field (see Abstr. 4171/1937 and 3037/1938). This produces a polarization of the dielectric which is destroyed on further irradiation in the absence of the field. Suitable exposure to a positive image produces a surface charge pattern which can be developed with charged pigment particles to give a positive reproduction. The present author describes experiments with evaporated polycrystalline films of sulphur 50 μ thick. Polarization (P) was carried out for 10 minutes with 2×10^{-6} watt/cm^2 illumination and ~ 5 kV/cm field. Development was with triboelectrically charged NaCl–asphalt particle mixtures. An example of an electrophotograph is shown. Measurements showed that optical density is proportional to P. In darkness P falls to ~ 40% of its initial value in about one week, after which it appears to remain constant. The photo-electret process differs in this respect from xerography in which the latent image decays rapidly. Photo-electret properties were also studied with single crystals of sulphur and anthracene, and images were obtained. The effects are interpreted in terms of localization of photo-excited carriers in deep traps, and their release on further irradiation. (See also Abstr. 7085-6 and 10 000/1957). C.H.L.Goodman

537.312.5 : 537.531.08

3133. SECONDARY-ELECTRON MULTIPLIERS FOR RECORDING LONG-WAVELENGTH X-RADIATION.
A.M.Tyutikov and A.I.Efremov.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 2, 286-8 (1958). In Russian.

Geiger counters and photographic plates are too insensitive as detectors for wavelengths of 10 A and greater. Direct photomultipliers using Be–Cu electrodes are much more sensitive since no isolating window is required. These detectors, however, deteriorate in the presence of air. The authors describe a photomultiplier using beryllium–bronze electrodes in which the gain is 2×10^6 and which is much more stable than the older type of detector. T.Mulvey

537.312.5 : 621.383

3134. PHOTO-ELECTRIC RICHARDSON EQUATION AND A THEORY OF THE SPECTRAL DISTRIBUTION OF PHOTO-CATHODES. P.Görlich, H.Hora and W.Macke.
Exper. Tech. der Phys., Vol. 5, No. 5, 217-21 (1957). In German.

The product of quantum efficiency and transmission factor of a photo-cathode is plotted against frequency, using Richardson's equation, with r = 2 and 3 (r is the temperature exponent, which tends to 3 for short wavelength radiation). J.Franks

537.312.5

3135. SOME PHOTOELECTRIC PROPERTIES OF CHLOROPHYLL. R.C.Nelson.
J. chem. Phys., Vol. 27, No. 4, 864-7 (Oct., 1957).

Both chlorophyll-a and methyl chlorophyllide-a have been found to be photoconductive in films deposited from solvents. The photoconductivity of methyl chlorophyllide-a resembles that of some cyanine dyes in having two time constants for rise and decay, one less than a second, and the other of the order of several minutes. The action spectrum of the "fast" photoconductivity is similar to the absorption spectrum of the pigment, the red peak falling at 6740 A. Both pigments sensitize photoconductivity in CdS films, and the contact potential difference at the interface is of the correct sign to permit electron transfer from dye to crystal. These properties give some support to Katz's hypothesis regarding the primary process in photosynthesis. A.

537.312.5

3136. PHOTOCONDUCTIVITY OF ANTHRACENE. IV. BULK PHOTOCONDUCTION IN SINGLE CRYSTALS.
J.Kommandeur and W.G.Schneider.
J. chem. Phys., Vol. 28, No. 4, 582-9 (April, 1958).

For Pt III see Abstr. 9696 (1957). The measurements were made using monochromatic light. The intensity and voltage dependences were found to depend on the field direction and the wavelength of the exciting light. The spectral response of photoconduction depends on the field direction. A model is proposed to account for these observations and for the space charge effects that are found to occur. This model rests mainly on the assumptions of a higher mobility for the positive charge carriers and the non-replenishment of charge carriers at the evaporated Ag electrodes. Recombination of carriers is deduced, and a quantitative relationship between spectral response and extinction coefficient is found. A.

537.312.5

3137. PHOTOCONDUCTIVITY OF ANTHRACENE. V. EFFECT OF IMPERFECTIONS ON THE BULK PHOTOCURRENT.
J. Kommandeur and W.G.Schneider.
J. chem. Phys., Vol. 28, No. 4, 590-5 (April, 1958).

For Pt IV see preceding abstract. Bulk photocurrents of anthracene were measured on crystals of high purity, scintillation crystals, and crystals irradiated with thermal neutrons. It is found that the source and treatment of the crystals strongly affects the spectral response and the voltage and intensity dependence of the bulk photocurrent. This can be related to the density of the imperfections in the crystals. Direct evidence for the existence of traps was furnished by the electrical analogue of the thermoluminescent glow curves and by the increase of the photocurrents with red radiation. A.

537.312.5 : 612.843

3138. RETINAL TYPE OF PHOTOVOLTAIC CELL. I.Levin.
Nature (London), Vol. 181, 832 (March 22, 1958).

Outlines the construction of a multiple electrode photovoltaic cell in which the individual electrodes are completely inert, the seat of photopotential being in the space charge formed just around the point electrode during the irradiation. The apparatus provides one step in the development of a working model of the retina.
C.A.Hogarth

537.312.5 : 539.166.08

3139. THE LONGITUDINAL ANGULAR DEPENDENCE OF THE PHOTOELECTRIC EFFECT AND ITS INFLUENCE ON THE DETERMINATION OF GAMMA RAY INTENSITIES.
S.Hultberg and T.Novakov.
Nuclear Phys., Vol. 4, No. 1, 120-4 (Aug., 1957).

The longitudinal angular distribution of photoelectrons has been measured over the whole angular range ($-\pi \leq \theta \leq \pi$) for three different gamma-ray energies. A 4 mg/cm^2 U foil was used as converter. From the experimental curves it is possible to obtain relative photoelectric cross-sections by integration from $\theta = 0$ to $\theta = \theta_0$, where θ_0 is a limiting angle defined by the geometry of the experimental set-up. A comparison of the measured angular distributions has been made with theory showing for certain characteristic quantities an essential agreement. Also, some interesting deviations have been observed. The study of photoelectron lines as a precise method for determining relative gamma-ray intensities is discussed. The method has been applied to the decay of Bi^{206} where relative intensities of about 20 gamma-rays have been determined with an instrumental resolution of 0.4% at high energies. A.

537.312.5 : 535.41 : 535.14

CORRELATION IN PHOTOELECTRON EMISSION.
See Abstr. 2932-3

537.312.5

3140. PHOTOVOLTAGES LARGER THAN THE BAND GAP IN ZINC SULFIDE CRYSTALS. S.G.Ellis, F.Herman, E.E.Loebner, W.J.Merz, C.W.Struck and J.G.White.
Phys. Rev., Vol. 109, No. 5, 1860 (March 1, 1958).

Previous studies by Pensak (Abstr. 2332/1958) on abnormally high photovoltages across CdTe films were extended to ZnS crystals. Similar effects were found in the latter, particularly when stacking faults were present, and fields of 100 V/cm were detected.
G.F.J.Garlick

537.312.5 : 537.531

3141. CHARACTERISTICS OF THE ADDITIONAL CONDUCTIVITY OF CADMIUM SELENIDE SINGLE CRYSTALS UNDER X-RAY EXCITATION. I. STATIC CHARACTERISTICS. S.V.Svechnikov.
Zh. tekh. Fiz., Vol. 27, No. 11, 2492-501 (1957). In Russian.

The single CdSe crystals were prepared by direct combination of a mixture of Cd and Se vapours in an atmosphere of argon at 1000-1200°C. For the experimental work specimens with excess Se were used which, immediately after preparation, were characterized by high dark-resistivity and low ($\sim 10^{-8}$ A) values of the photocurrent. A vacuum treatment increased the photo-current of the crystals to about 10^{-5}-10^{-4} A and decreased their dark resistance to 10^{8}-$10^{7}\Omega$. The excitation spectra of these crystals occupied a narrow range of wavelengths with the maximum at ~ 7500 A, and resembled those of CdS single crystals except that the spectra of CdSe crystals displayed short-wavelength "tails". Investigation of the current–voltage and current–excitation intensity characteristics under X-ray irradiation showed them both to be superlinear. According to the present author a satisfactory explanation of the experimental results can be given in terms of the hypothesis of the space charges in semiconductors (Abstr. 4645/1955) and of the theory of double optical transitions, due to Lashkarev and Fedorus (Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 16, 81, 1952).
M.H.Sloboda

537.312.5 : 537.531

3142. CHARACTERISTICS OF THE ADDITIONAL CONDUCTIVITY OF CADMIUM SELENIDE SINGLE CRYSTALS UNDER X-RAY EXCITATION. II. KINETIC CHARACTERISTICS. S.V.Svechnikov.
Zh. tekh. Fiz., Vol. 27, No. 11, 2502-6 (1957). In Russian.

The effect of: (a) intensity of X-ray radiation (16-80 roentgens/min), (b) intensity and wavelength (4000-7000 A) of illumination in the visible part of the spectrum, (c) magnitude of the applied electric field (80-160 V), and (d) temperature (20-200°C) on the time constant of the photo-current in single crystals of CdSe was investigated. The experimental results were found to be in good agreement with those calculated on the basis of (i) the hypothesis of space-charge current associated with the impurities and (ii) the theory of double optical transitions (see the preceding abstract).
M.H.Sloboda

537.312.5 : 537.371

PHOTOCONDUCTION OF SILVER-ACTIVATED CADMIUM SULPHIDE. See Abstr. 2248

537.312.62

3143. PENETRATION OF MAGNETIC FIELDS THROUGH SUPERCONDUCTING FILMS. A.L.Schawlow.
Phys. Rev., Vol. 109, No. 5, 1856 (March 1, 1958).

Using hollow cylindrical Sn films, 700 to 900 A thick, subjected to 500 c/s a.c. fields at temperatures of from 2.2° to 3.2°K, it is found that the ratio H_I/H_O of the field detected inside the cylinder to that applied outside is about 10^{-4}. On the London theory, this would imply a penetration depth λ_0 at 0°K of about 1000 A, twice the commonly accepted value. Using the Pippard theory (see following abstract), and taking λ_0 = 510 A, the results imply a range of coherence ξ in the films of about 1200 A, if the range ξ_0 in bulk metal is taken to be 2500 A, as given by the B.C.S. theory. This reasonable value for ξ is taken as evidence in favour of the non-local Pippard–B.C.S. theory. R.G.Chambers

537.312.62

3144. PENETRATION OF ELECTROMAGNETIC FIELDS THROUGH SUPERCONDUCTING FILMS. M.Peter.
Phys. Rev., Vol. 109, No. 5, 1857-8 (March 1, 1958).

The relation between current and field suggested by Pippard (Abstr. 4106/1953) and supported by the B.C.S. theory is modified to apply to thin films, and solved by an iterative method for small d/ξ, where d is the film thickness and ξ the range of coherence. The resulting variation of field and current across the film is plotted for $d/\xi = 0.2$. R.G.Chambers

537.312.62

3145. THE INTERMEDIATE STATE STRUCTURE IN CYLINDRICAL SUPERCONDUCTORS. J.F.Cochran and R.S.Kaeser.
Physica, Vol. 23, No. 8, 727-45 (Aug., 1957).

The average magnetic moment per unit volume of a long cylinder consisting of alternate disks of superconducting and normal material was measured in a transverse magnetic field as a function of the disk thicknesses. Using the data so obtained, in conjunction with a laminar model of the intermediate state structure in transverse superconducting cylinders, it is possible to calculate the dependence of the structure periodicity, p, as a function of applied field, H, and the dimensionless ratio Δ/r_0, where r_0 is the cylinder radius and Δ is a parameter which characterizes the magnitude of the surface free energy at the boundary between normal and super-

conducting phases. For H lying between the limits $0.62\ H_C < H < 0.75\ H_C$ the result can be expressed simply as $p = 6.3\ H_C/H\ \sqrt{\Delta/r_0}$. The dependence of the magnetization on applied field is also calculated, and is used to obtain values of Δ for tin from magnetization and resistivity data on thin tin wires. A.

537.312.62

3146. ON THE MOTION OF THE BOUNDARY BETWEEN THE NORMAL AND THE SUPERCONDUCTIVE STATE IN A CYLINDRICAL WIRE CARRYING A STRONG CURRENT.
C.J.Gorter and M.L.Potters.
Physica, Vol. 24, No. 3, 169-76 (March, 1958).

The inward motion of the boundary between the superconductive core and the normally conducting sheath in a cylindrical wire through which a large current is passed is calculated by computing the solution of Maxwell's equations in the normally conductive region. If superconductivity is re-established immediately when the local field drops below the critical value, F.London's result for the resistance is found. If supercooling retards the re-establishment of superconductivity, a periodic motion of the boundary may result accompanied by a slight increase of the average resistance. Orders of magnitude of periods and upper limits of resistance variations are estimated. A.

537.312.62

3147. ON THE GROUND STATE OF SUPERCONDUCTORS.
C.G.Kuper.
Physica, Vol. 24, No. 4, 304-12 (April, 1958).

In the theory of Bardeen, Cooper and Schrieffer, it is argued that the wave-function must contain electron-pair correlations. With several simplifying assumptions in the Hamiltonian, it then becomes possible to solve an integral equation for the wave-function. In the present work, a more restricted class of trial wave-functions is used, so that fewer approximations need be introduced into the Hamiltonian. The role of the Coulomb repulsion is discussed in some detail. The results do not differ qualitatively from those of Bardeen, Cooper and Schrieffer. A.

537.312.62 : 538.112

3148. MEASUREMENT OF THE DEPTH OF PENETRATION OF A MAGNETIC FIELD INTO MERCURY FILMS. I.S.Khukhareva.
Zh. éksper. teor. Fiz., Vol. 33, No. 7(1), 301-3 (1957). In Russian.

The paper summarizes very briefly the various methods of preparation of thin mercury films and determination of their thickness by weighing. Results are given of measurements of the variation of resistance of a film with temperature and also of determinations at various temperatures of the curves of transition from superconducting to normal state with increase of magnetic field applied parallel to the plane of the film. The Ginzburg–Landau formula is used to calculate the penetration depth and the results are used to derive an apparently very satisfactory temperature–depth of penetration relationship. C.R.S.Manders

537.312.62 : 539.2

THEORY OF ELECTRON PARAMAGNETIC RESONANCE IN SUPERCONDUCTORS. See Abstr. 2657

537.323 : 536.4

3149. THERMOELECTRIC PROPERTIES OF BISMUTH TELLURIDE AND ITS ALLOYS. D.A.Wright.
Nature (London), Vol. 181, 834 (March 22, 1958).

A thermoelectric cooling of 65° (mean junction temperature 17°C) was obtained with best n- and p-type Bi_2Te_3. Hall mobility of n-type material reached 300 $cm^2\ V^{-1}sec^{-1}$. Alloy systems studied included (Bi, Sb) tellurides, Bi selenotellurides and Bi sulphotellurides. The best junctions prepared had a mean figure of merit of 0.049, corresponding to 80°C cooling (mean temperature 17°C). See also Abstr. 9673 (1955) and 7127 (1957). C.H.L.Goodman

537.36

3150. U-EFFECT, II, AN ELECTROKINETIC PHENOMENON.
W.W.Fain, S.L.Brown and A.E.Lockenvitz.
J. Acoust. Soc. Amer., Vol. 29, No. 8, 902-8 (Aug., 1957).

When a glass capillary tube filled with a column of alternate layers of mercury and an electrolytic solution is forced to vibrate mechanically, an a.c. voltage is generated across the ends of the column. Certain aspects of this electrokinetic phenomenon have been investigated both experimentally and theoretically. Data are presented for: (1) The tube output voltage v. amplitude of vibration at fixed frequencies of vibration. (2) The tube output voltage v. frequency of vibration at fixed amplitudes of vibration. (3) Output impedance during vibration for constant unloaded tube output voltage v. frequency of vibration. A.

537.36

3151. STREAMING CURRENTS IN TURBULENT FLOWS AND METAL CAPILLARIES. I. THEORY. (1) DISTRIBUTION OF CHARGE IN THE LIQUID. A.A.Boumans.
Physica, Vol. 23, No. 11, 1007-26 (Nov., 1957).

Since the idea was suggested of constructing a h.t. generator in which the high tension is built up by the streaming current, a detailed theoretical and experimental investigation of this phenomenon has been undertaken. After a general introduction, the distribution of charge in an electrolytic solution in a tube is calculated following the procedure of Debye and Hückel. An exchange of charge between wall and liquid appears to influence this charge distribution not perceptibly if the wall current density J causes a voltage across the diffuse layer thickness $1/k$ which is small with respect to the ζ-potential, i.e. $J \ll \sigma k \zeta$ where σ is the conductivity of the liquid. In relevant cases the influence of this exchange on the ζ-potential can be neglected. It is shown that turbulence does not influence the charge distribution if the time required to travel with the r.m.s. value of turbulent cross velocity (roughly equal to friction velocity v_*) across the diffuse layer thickness $1/k$ is large compared with the liquid's relaxation time τ, i.e. $\tau v_* k \ll 1$. Charge distribution in the turbulent core of the flow becomes homogeneous if $\tau v_* k \gg 1$. A.

537.36

3152. STREAMING CURRENTS IN TURBULENT FLOWS AND METAL CAPILLARIES. II. THEORY. (2) CHARGE TRANSPORTED BY THE FLOW OF LIQUID. A.A.Boumans.
Physica, Vol. 23, No. 11, 1027-37 (Nov., 1957).

The mean charge density which appears if a liquid flows through a tube is calculated, dimensionless numbers being used. All results are valid for flow through round tubes as well as between parallel walls. A.

537.36

3153. STREAMING CURRENTS IN TURBULENT FLOWS AND METAL CAPILLARIES. III. EXPERIMENT. (1) AIM AND PROCEDURE. A.A.Boumans.
Physica, Vol. 23, No. 11, 1038-46 (Nov., 1957).

Using a preliminary liquid high-tension generator, a tension of 70 kV at a current of 0.1μA was reached. The measurements on the streaming current were carried out by means of a simple compensation method which allows currents from 3×10^{-13} A upwards to be detected. It was possible to distinguish the contributions of the pure streaming current and the exchange of charge between liquid and tube wall. Measurements were performed with refined gasoline flowing through a number of brass capillaries varying in length from 15 to 60 mm, in diameter from 0.5 to 3 mm, and of different cross-section shape, entrance disturbance and wall roughness. It appeared from first measurements that a stationary situation may not be reached until after some minutes. A.

537.36

3154. STREAMING CURRENTS IN TURBULENT FLOWS AND METAL CAPILLARIES. IV. EXPERIMENT. (2) RESULTS AND CONCLUSIONS. A.A.Boumans.
Physica, Vol. 23, No. 11, 1047-55 (Nov., 1957).

It is shown that the streaming current in metal tubes is supplied by the wall of the tube; glass tubes give comparatively less streaming current. The mean charge density $\bar{\rho}$ in the liquid is strongly dependent on temperature T, especially if $T > 20^0$C; if the liquid is heated to 60°C its ability to produce charge is lost rapidly. The experimental $\bar{\rho}$(Re) and $\bar{\rho}$(R, L) curves, describing the dependence of $\bar{\rho}$ on Reynolds number Re, tube length L and tube radius R, show a clear resemblance to the theoretical curves deduced in Pt I. It is found that wall roughness and entrance disturbance influence $\bar{\rho}$ strongly. Finally with the results obtained a calculation is made of the components required for a 1 MV 0.1 mA h.t. generator in which the high tension is built up by the streaming current. A.

ELECTRIC DISCHARGES

537.521

3155. DETERMINATION OF THE EQUILIBRIUM TEMPERATURE OF A PLASMA. P.J.Dickerman.
J. appl. Phys., Vol. 29, No. 3, 598 (March, 1958).

Using the Holtsmark theory of the Stark effect broadening by an inhomogeneous electric field in conjunction with the Debye and Saha equations, temperature values were obtained by analysis of the

Balmer series lines in hydrogen at a pressure of 1 atm and densities of 10^{16} to 10^{17} particles/cm^3. The method is suitable for temperatures between 10 000° and 18 000° K, and hydrogen contents down to 1% of the total pressure. A.E.D.Heylen

537.523 : 621.317.326.015.533

3156. RESEARCH ON THE HIGH-FREQUENCY SURFACE DISCHARGE. T.Honda.
Mem. Fac. Engng Kumamoto Japan, Vol. 4, No. 1, 1-12 (March, 1957).

A detailed experimental study of Lichtenberg figures produced by high-frequency pulsed discharges (~1-7 Mc/s, pulse lengths varying from ~10^{-6} to 10^{-3} sec). The different phases of the discharges, separable on a time scale, are described. J.D.Craggs

537.525

3157. CERTAIN CHARACTERISTICS OF THE DISCHARGE IN Hg-Ne MIXTURES. G.M.Malyshev and B.V.Pavlov.
Vestnik Leningrad. Univ. Ser. Fiz. Khim. No. 3 (1957) No. 16, 32-40. In Russian.

A discharge tube with heated cathode and a number of Langmuir probes was used and the electrical and optical (i.e. visual and spectroscopic) characteristics of the discharge observed along the positive column. Hg-Ne mixtures were employed with Hg vapour pressure of about 10^{-3} Hg and Ne varying from 10^{-3} to 1 mm. Discharge currents covered the range 100 to 400 mA. C.R.S.Manders

537.525 : 538.561

3158. THEORY OF DIFFUSION VIBRATIONS IN THE PLASMA OF A GAS DISCHARGE. O.V.Prudkovskaya.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 4, 601-4 (1957). In Russian.

An analysis of the general dispersion equation of the diffusion vibrations shows that in real plasmas with Debye radii ~ 10^{-2} to 10^{-3} cm quasi-neutral waves are produced. Equations are presented describing these vibrations in strong and weak electric fields; the dispersion equation becomes too complicated for mathematical analysis in the case of intermediate field strengths owing to the high algebraic powers of the wave-numbers involved. In very weakly charged plasmas electron and ion waves are possible. Electrical Research Association

537.525.8 : 621.387

3159. HOLLOW-CATHODE GLOW DISCHARGE IN MERCURY VAPOR. K.G.Hernqvist.
R.C.A. Rev., Vol. 19, No. 1, 35-48 (March, 1958).

The hollow-cathode glow discharge operates with a metal cathode having a spherical cavity and a small exit aperture. The main glow is situated inside the cathode cavity. This discharge has been operated in mercury vapour by keeping the inside of the cavity wetted with mercury. The volt–ampere characteristic does not exhibit any regions of negative resistance. An analysis based on the energy balance relation is shown to yield a volt–ampere characteristic which is in good agreement with experiment. Microwave measurements of the plasma density also corroborate the analysis. These studies indicate that plasma densities in excess of 10^{15} per cm^3 may be attained in this discharge. A.

537.527.5

3160. SOME INVESTIGATIONS ON ARC DISCHARGES IN HELIUM AND HYDROGEN AT HIGH PRESSURES.
A.Michels, H.Tjin a Djie, H.de Kluiver and C.A.ten Seldam.
Physica, Vol. 23, No. 12, 1115-25 (Dec., 1957).

In a high-pressure discharge cell direct current arcs were investigated in hydrogen and helium compressed up to 1000 atm. For helium, the current, the voltage across the arc and its diameter were measured as a function of pressure. From these data the temperature in the positive column was calculated with the assumption that the Saha equation is valid under the experimental conditions. For hydrogen, preliminary experiments also yielded an estimate of the temperature. Photographic analyses of the spectra of H_2 and He were made. As some H_2 was present in the He used, it was also possible to observe the effect of high-density He on the H_2 spectrum. Finally, the total intensity of the helium arc in the range 4000-6500 A was determined photoelectrically as a function of pressure. A.

537.528 : 621.315.615

3161. BREAKDOWN OF LIQUID INSULATING AND DIELECTRIC MATERIAL. J.A.Kok and M.M.G.Corbey.
Appl. sci. Res. B, Vol. 6, No. 3, 197-206 (1956).
See also following abstract.

537.528 : 621.315.615

3162. TESTING THE ELECTRIC STRENGTH OF LIQUID DIELECTRIC OR INSULATING MATERIAL.
J.A.Kok and M.M.G.Corbey.
Appl. sci. Res. B, Vol. 6, No. 4, 285-95 (1957).

The reduction in electric strength of liquids, due to the presence of colloidal particles is discussed. J.H.Mason

537.528

3163. THE ELECTRIC STRENGTH AND MOLECULAR STRUCTURE OF LIQUIDS. T.J.Lewis.
Brit. J. appl. Phys., Vol. 9, No. 1, 30-3 (Jan., 1958).

Further measurements of the electric strength of liquids are used to support the theory of a breakdown criterion, suggested in an earlier paper (Abstr. 5129/1956), in which conduction electrons in the liquid excite molecular vibrations associated with individual groups within the molecules. It has been demonstrated that collision cross-sections could be assigned to these groups and the breakdown strength derived. This criterion is used to relate the breakdown strengths of a series of alkyl benzenes recently measured by Sharbaugh, Crowe and Cox (Abstr. 6680/1956) and a cross-section for the benzene ring is determined. The additive effect of the various group cross-sections is found as before, but it is necessary to consider dipole effects as well as liquid structure in order to explain the increased cross-section values for the alkyl groups. The general correctness of the concept is further demonstrated by measurements of the strength of a series of dimethyl siloxanes. It is assumed that cross-sections are to be associated with the oxygen sites and also with the methyl groups. The value of the methyl cross-section determined in this case is identical with that found from the previous measurements on the alkanes. Lastly, the presence of a puckered ring structure as well as steric hindrance is suggested as the cause of the strength of cyclohexane calculated from alkane measurements being different from the measured value. A.

X-RAYS

537.531

3164. X-RAY EMISSION LINES OF THE K_β-GROUP OF TITANIUM IN CARBIDES. É.E.Vaĭnshteĭn and Yu.N.Vasil'ev.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 4, 741-4 (1957). In Russian.

For carbon contents 9-24% the spectral location of the K_β-lines remains constant but the relative intensities of the lines change. In particular, as the carbon content is increased the relative intensity of the K_β''-line increases. Z.Krasucki.

537.531

3165. ON THE SATELLITES OF THE LINES $L\alpha_{1,2}$ AND $L\beta_1$ IN THE SPECTRUM OF GERMANIUM.
G.P.Borovikova and M.I.Korsunskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 1, 75-7 (1957). In Russian.

In the X-ray emission spectrum of germanium satellite lines were found, $L\beta_6$ corresponding to the transition L_{III}-N_I, $L\gamma_5(L_{II}$-$N_I)$ and $L\gamma_{2,3}(L_I$-$N_{II-III})$. In Ge the wavelengths in X-units were: $L\alpha_{1-2}$ 10408; $L\beta_6$ 10365: $L\beta_1$ 10146; $L\gamma_1$ 10103, and in GeO_2: $L\alpha_{1-2}$ 10415; $L\beta_1$ 10155. A.L.Mackay

537.531

3166. EXCITATION OF CHARACTERISTIC K X-RAYS FROM ELEMENTS BY PROTONS, DEUTERONS, AND ALPHA PARTICLES. B.Singh.
Phys. Rev., Vol. 107, No. 3, 711-15 (Aug. 1, 1957).

The excitation of characteristic K X-rays from Cu and Ag by bombardment of protons, deuterons and alpha particles were studied. The charged particles were accelerated by an electrostatic generator and the resulting characteristic K X-rays from thin targets were detected by a proportional counter of good resolution and known efficiency. The counter used can count X-rays of energy between 2.0 and 50.0 keV with high efficiency. The pulses from the counter were analysed by a fifty-channel kick-sorter and the number of X-ray quanta produced was determined by well-defined differential curves. After correcting for the Auger transition, the absolute cross-section for K-shell ionization was measured for the accelerated particles of different energies and compared with the theoretical cross-section obtained by using the formula of Lewis, Simmons and Merzbacher (Abstr. 7920/1953) deduced from the theory of Henneberg. A.

537.531

3167. RADIATIVE YIELDS OF THE K SERIES IN π-MESONIC ATOMS. M.Stearns and M.B.Stearns.
Phys. Rev., Vol. 107, No. 6, 1709-11 (Sept. 15, 1957).

The total radiative yields of the K-series lines from π-mesonic atoms were measured for the elements Li through F, inclusive, and Na. The yield is a maximum at Be, 21%, and falls to about 3% at Na. The yields of N, O, and F are roughly comparable. This anomaly may be due to a magic-number effect at Z = 8. A.

537.531.08 : 535.377

3168. MILLIROENTGEN DOSIMETRY WITH THERMO-LUMINESCENCE. D.A.Patterson and H.Friedman.
J. Opt. Soc. Amer., Vol. 47, No. 12, 1136-7 (Dec., 1957).

A thin layer of phosphor $CaSO_4$: Mn deposited on Al foil is irradiated with 70 kV X-rays, and afterwards heated. The resulting thermoluminescence, directed by a polished light-guide to a photomultiplier, is linearly proportional to irradiation dosage down to a measured 10 mr, and justifiable extrapolation to doses of 0.2 mr can be made. Fairly rapid decay of the light sum occurs after exposure, but the possibility of reducing this by varying the Mn concentration or using co-activators is suggested.

D.V.Mabbs

537.531.08 : 537.312.5

RECORDING LONG-WAVELENGTH X-RADIATION.
See Abstr. 3133

537.531.8 : 535.822

3169. X-RAY IMAGE CONVERTER MICROSCOPY. L.Y.Huang.
Z. Phys., Vol. 149, No. 2, 225-53 (1957). In German.

A suitable object is placed in contact with a Ag foil 500 A thick. An electron contact image is obtained in the foil by irradiating the specimen with X-rays. Photo-electrons are released by the X-rays, which in turn create low energy secondary electrons in the Ag foil. The intensity of the electron image depends on the mass thickness of the object. This electron image is magnified by a $\times$400 electrostatic immersion objective. A resolution of 300 A is theoretically possible. A resolution of 2500 A was reached with the present apparatus. T.Mulvey

537.531.85 : 539.2

3170. X-RAY SCATTERING BY THERMAL AGITATION AND THE COMPTON EFFECT IN FLUORITE. D.Cribier.
Rev. mod. Phys., Vol. 30, No. 1, 228-9 (Jan., 1958).

The intensity of Compton scattering is derived by subtracting the estimated thermal scattering from the observed diffuse scattering. See also following abstract. A.R.Stokes

537.531.85 : 539.2

3171. COMPTON SCATTERING OF X-RAYS IN CRYSTALS. H.Curien.
Rev. mod. Phys., Vol. 30, No. 1, 232-4 (Jan., 1958).

Four possible interactions of a photon with a crystal are listed: Bragg scattering, thermal scattering, Compton scattering and photoelectric absorption. Methods of obtaining experimental estimates of Compton scattering are discussed. A.R.Stokes

CATHODE RAYS. POSITIVE RAYS

537.533 : 537.534 : 621.384.6

3172. THEORY OF THE ALTERNATING-GRADIENT SYNCHROTRON. E.D.Courant and H.S.Snyder.
Ann. Phys. (New York), Vol. 3, No. 1, 1-48 (Jan., 1958).

The equations of motion of the particles in a synchrotron in which the field gradient index

$$n = -(r/B)\partial B/\partial r$$

varies along the equilibrium orbit are examined on the basis of the linear approximation. It is shown that if n alternates rapidly between large positive and large negative values, the stability of both radial and vertical oscillations can be greatly increased compared to conventional accelerators in which n is azimuthally constant and must lie between 0 and 1. Thus aperture requirements are reduced. For practical designs, the improvement is limited by the effects of constructional errors; these lead to resonance excitation of oscillations and consequent instability if $2\nu_x$ or $2\nu_z$ or $\nu_x + \nu_z$ is integral, where ν_x and ν_z are the frequencies of horizontal and vertical betatron oscillations, measured in units of the frequency of revolution. The mechanism of phase stability is essentially the same as in a conventional synchrotron, but the radial amplitude of synchrotron oscillations is reduced substantially. Furthermore, at a "transition energy" $E_1 \approx \nu_x Mc^2$ the stable and unstable equilibrium phases exchange roles, necessitating a jump in the phase of the radiofrequency accelerating voltage. Calculations indicate that the manner in which this jump is performed is not very critical. A.

537.533 : 621.385.833

3173. SMALL SIGNAL POWER THEOREM FOR ELECTRON BEAMS. H.A.Haus and D.L.Bobroff.
J. appl. Phys., Vol. 28, No. 6, 694-704 (June, 1957).

An analysis is presented of a filament beam in arbitrary d.c. electric and magnetic fields. The trajectory of the filament beam in the absence of a.c. fields may thus follow an arbitrary curve. It is shown that the electromagnetic power delivered by the filament beam is, within the assumptions of small-signal theory, balanced by a decrease in the beam of a quantity, the "generalized a.c. power" in the beam. This a.c. power involves products of the small-signal beam-excitation amplitudes. The a.c. power theorem for a filament beam can be extended to a thick beam. This is done to find the small-signal a.c. power theorem for a two-dimensional rectilinear beam of finite thickness. The power theorem presented here is applicable to M-type and E-type travelling-wave devices. Applications to the noise theory and signal analysis of electron beams are indicated. A.

537.533

3174. USE OF SCANNING SLITS FOR OBTAINING THE CURRENT DISTRIBUTION IN ELECTRON BEAMS. K.J.Harker.
J. appl. Phys., Vol. 28, No. 11, 1354-7 (Nov., 1957).

In axially symmetric electron beams, the current density (as a function of radius) may be rather easily related to the current through a narrow slit (as a function of slit position) by means of an integral equation. A similar equation applies to scanning by a straight edge. The solution of the integral equation is obtained, and a simple technique for rapid numerical evaluation of the resulting ordinary equation is included. The relations derived are of particular interest in the large number of cases where the mechanical simplicity of slit or straight-edge scanning makes these methods preferable to the more common pinhole method. The resolving powers for slit and pinhole scans are compared. A.

537.533.08 : 621.385.833 : 621.317.79

3175. ELECTRON BEAM ANALYZER. A.Ashkin.
J. appl. Phys., Vol. 28, No. 5, 564-9 (May, 1957).

A new technique is described for measuring the charge distribution of an electron beam in a magnetic field. The method is especially applicable to the long, thin, high-current beams commonly used in travelling-wave tubes and backward-wave oscillators. It consists of making the beam trace out its own characteristics by sweeping it across a pinhole in crossed electric and magnetic fields. The data are presented in the form of oscilloscope pictures of the actual charge distribution. Quantitative measurements of the charge distribution are also available. A.

537.533.2

3176. TRANSMISSION OF ELECTRONS THROUGH METAL SURFACES. R.H.Good, Jr.
J. appl. Phys., Vol. 28, No. 12, 1405-8 (Dec., 1957).

A review is presented of recent developments in the theory of electron emission from metals. The main subjects discussed are the periodic deviations in the Schottky effect and the transition between thermionic and field emission. The indications are that each of these phenomena can be understood in terms of the free electron model for the metal and the transmission of the electrons through the image force-barrier at the metal surface. A.

537.533.2 : 541.183

3177. ADSORPTION OF CO ON TUNGSTEN AND ITS EFFECT ON THE WORK FUNCTION. J.Eisinger.
J. chem. Phys., Vol. 27, No. 5, 1206-7 (Nov., 1957).

Describes measurements of the variation of the work function Φ of single-crystal W ribbon as a function of the number N of adsorbed CO molecules. Φ increased from 4.5 eV with N = 0, to 5.4 eV with $N = 5.4 \times 10^{14}$ molecules/cm^2. C.G.Morgan

537.533.2

3178. ENERGY DISTRIBUTION HALF-WIDTHS FOR FIELD EMISSION ELECTRONS. E.L.Murphy.
J. appl. Phys., Vol. 29, No. 5, 758-9 (May, 1958).

The results of a numerical treatment of the dependence of half-widths of electron energy distribution on temperature, field, and

work function are presented for the electrons emitted from a metal at temperatures and fields within the extended field emission range. For the distribution, the width of the peak at half maximum and the partial widths from peak to half-maximum on either side are presented graphically as a function of one parameter depending on temperature, field, and work function. The peak energy can also be determined in terms of this parameter. A.

537.533.3 : 621.397.611

3179. BEAM TEMPERATURE, DISCHARGE LAG AND TARGET BIASING IN SOME TELEVISION PICK-UP TUBES.
B.Meltzer and P.L.Holmes.
Brit. J. appl. Phys., Vol. 9, No. 4, 139-43 (April, 1958).

Discharge lag in pick-up tubes, particularly of the modern cathode-potential-stabilized type, and its relation to the acceptance of the electron beam by the target are analysed. Measurements of beam acceptance as a function of target potential reveal effective beam temperatures substantially equal to cathode temperature at low beam currents, but higher and multi-valued at high currents. These temperatures set a limit to the possible reduction of lag without target biasing; this limiting lag, referred to as Maxwellian lag, is calculated and presented graphically. Direct measurements of lag are compared with the limiting values. Target biasing, the application of a small positive potential to the target face, reduces this limitation. Results of electron-optical measurements, throwing some light on the anomalous beam temperatures, are presented. A.

537.533.3 : 621.385.833

3180. TRANSVERSE SCALING OF ELECTRON BEAMS.
G.Herrmann.
J. appl. Phys., Vol. 28, No. 4, 474-8 (April, 1957).

Under certain conditions an electron beam can be subjected to a process of scaling, in which the transverse components of position, velocity and force are scaled by a common factor, while longitudinal components remain unchanged. In analysing beams produced by electron guns under conditions where thermal velocity effects have to be taken into consideration, the application of transverse scaling simplifies the treatment by allowing a reduction in the number of independent parameters required. Design curves for Pierce-type guns are reproduced in normalized and condensed form. These curves may be used in choosing design parameters to produce a prescribed beam. A.

537.533.3 : 621.385.833

3181. INVESTIGATION OF FIFTH-ORDER ABERRATION IN ELECTRON OPTICAL SYSTEMS OF AXIAL SYMMETRY.
Wu Mŷ-Cheng.
Scientia Sinica, Vol. 6, No. 5, 833-46 (Oct., 1957). In Russian.

The eikonal method is used to deduce the total aberration of the fifth-order in combined electric and magnetic fields of axial symmetry. Expressions are developed for the various components of the aberration. Finally, the fifth-order distortion is evaluated for two particular cases. This aberration is important, for example, in electron image tubes. T.Mulvey

537.533.332 : 621.385.833

3182. THE CORRECTION OF APERTURE ABERRATIONS IN A SYSTEM OF TWO MAGNETIC QUADRUPOLE LENSES. A.Septier.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 2036-9 (Dec. 4, 1957). In French.

It is shown that the aperture aberration of this system can be totally corrected by placing steel rods in the gap between the pole pieces at a certain critical distance from the axis. A similar effect could be produced by the use of octupole lenses.

A.E.I. Research Laboratory

537.533.332 : 621.385.833

3183. ASYMMETRIC MAGNETIC ELECTRON LENSES.
P.Durandeau, C.Fert and P.Tardieu.
C.R. Acad. Sci. (Paris), Vol. 246, No. 1, 79-81 (Jan. 6, 1958). In French.

The focal properties and chromatic aberrations of asymmetric magnetic lenses are presented in the form of reduced curves, in which the minimum focal length obtainable is used as the unit of length. A.E.I. Research Laboratory

537.533.35 : 539.27 : 621.385.833

3184. REFLEXION ELECTRON MICROSCOPY AT HIGH ANGLES.
D.H.Page.
Brit. J. appl. Phys., Vol. 9, No. 2, 60-7 (Feb., 1958).

A commercial electron microscope was adapted for use as a reflection instrument with an angle of beam deviation of 26.5°. The resolution was, in general, severely limited by the chromatic aberration arising from excessive energy losses suffered by electrons scattered through large angles. However, when both the axial and field components of the aberration were minimized, within the limits imposed by the use of a commercial instrument, a resolution of 600 A was attained. Although this is inferior to the resolution of the reflection microscope at low angles of deviation, the high depth-of-field and the greatly reduced foreshortening give rise to a highly informative and readily interpreted image. Micrographs illustrate the method applied to specimens in the chemical, biological and metallurgical fields. A.

537.533.73 : 535.42

ELECTRON DIFFRACTION BY A RESTRICTED APERTURE.
See Abstr. 2258

537.533.74

3185. LOW-ENERGY ELASTIC SCATTERING OF ELECTRONS BY OXYGEN AND NITROGEN.
P.Hammerling, W.W.Shine and B.Kivel.
J. appl. Phys., Vol. 28, No. 7, 760-4 (July, 1957).

The elastic scattering of slow electrons by O and N is calculated by the method of phase-shifts. The Hartree potential gives a cross-section (2×10^{-15} cm^2) for O of the order of magnitude needed to agree with the experiments of Lamb and Lin (Abstr. 3196/1958) in air. Since the Hartree potential is known to be too weak (as it neglects exchange and polarization), this agreement is considered fortuitous. Exchange forces are introduced by a new approximation based on a suggestion of Slater (Abstr. 4113/1951) for bound atomic states. The exchange approximation is adjusted to fit the more elaborate calculation of Bates and Massey for zero energy and zero polarization. The addition of a reasonable polarization force results in an acceptable potential and closer agreement with experiment. A similar calculation is made for nitrogen. In this case the Hartree potential alone gives a cross-section which is too large. The inclusion of exchange and polarization leads to better agreement with the measurements in air. A.

537.533.9

3186. SPECTRAL CHARACTERISTICS OF THE RADIATION EMITTED BY ELECTRONS ACCELERATED IN A SYNCHROTRON.
D.H.Tomboulian and D.E.Bedo.
J. appl. Phys., Vol. 29, No. 5, 804-9 (May, 1958).

Expressions are developed for the average power radiated by a high-energy electron moving in a circular orbit. The instantaneous electron energy E(t) is assumed to vary with the time in accordance with $E(t) = E_m \sin^2(\pi t/2T)$. Spectral distributions are obtained corresponding to the radiation emitted over a partial or full acceleration interval. The numerical results predicted from the general relations are examined for a particular value of the peak energy E_m = 6.0 BeV and the orbital radius R = 86.14 ft. In the case of these parameters, the continuous spectrum attains a peak at 0.36 A. Other numerical calculations, related to the case where the radiation is collected only over the low-energy portion of the acceleration interval, indicate that it is feasible to utilize the continuum as a source for measurements in problems of interest to astrophysics and solid state spectroscopy. A.

537.534

3187. ON NEW POSSIBILITIES OF INCREASED EFFICIENCY OF CHARGED-PARTICLE ACCELERATORS. E.M.Moroz.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 1, 78-9 (1957). In Russian.

A new type of sectioned magnet system, with constant field, is suggested, which is of particular value for the microtron.

W.O.Lock

537.534

3188. "SYMMETRICAL" RING PHASOTRON WITH CROSSING BEAMS. A.A.Kolomenskiĭ.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 298-9 (1957). In Russian.

Note on utilizing the collisions of crossing beams of relativistic particles in a fixed-field alternating-gradient circular accelerator. It describes a variant of the accelerator (ring phasotron) with strong focusing, a magnetic field constant in time and sectors with alternating-gradient fields for the production of collisions of crossing beams in one and the same accelerator. W.Bezdel

537.534 : 539.17

3189. FISSION-FRAGMENT MASS SEPARATOR AND THE NUCLEAR CHARGE DISTRIBUTION OF FISSION FRAGMENTS OF A SINGLE MASS. B.L.Cohen and C.B.Fulmer.
Nuclear Phys., Vol. 6, No. 4, 547-60 (April [2], 1958).

An energetic fission fragment passing through a gas changes its charge frequently by electron capture and loss collisions with gas molecules. Its average charge ē is found to be very nearly proportional to velocity, so that magnetic deflection depends only on the

mass; thus, passing fission fragments through a gas-filled magnetic spectrograph gives mass separation. At low pressure the resolution is limited by the statistics of the electron capture and loss process; increasing the pressure to reduce this effect is eventually limited by energy loss and the resulting multiple scattering. However, before this occurs there is a pressure range where the resolution is limited by the nuclear charge distribution of fragments of a single mass. All of these effects were studied experimentally. The best resolution obtained for mass 97 fragments was 3.5% full width at half maximum (with 20 mm Hg of helium), of which 2.2% is due to the width of the nuclear charge distribution. Combining this with the results of a study of the dependence of ē on nuclear charge, gives the width of the nuclear charge distribution for mass 97 fragments as 2.4 ± 0.5 units. This is in agreement with determination from yields of shielded isotopes, but is in disagreement with the predictions of most theories. The best obtainable resolution from the mass separator is 4.5 mass units for light fragments. Several applications of the separator are described and others are suggested. A.

537.534.3 : 533.59

AN ION-RESONANCE SPECTROMETER FOR GAS ANALYSIS.
See Abstr. 2866-7

537.534.3 : 531.788.7 : 533.5

3190. GETTERING OF OXYGEN BY A NONOPERATING ION GAUGE. B.J.Todd.
J. appl. Phys., Vol. 29, No. 2, 232 (Feb., 1958).

Low sensitivity to oxygen was observed in a mass spectrometer with an ion gauge in the system, even when the gauge was cold. This is attributed to the gettering effect of the gauge. Considerable amounts of oxygen were detected when the gauge was outgassed.
J.W.Sturgess

537.534.3

3191. DERIVATIVE MASS SPECTROMETRY.
J.H.Beynon, S.Clough and A.E.Williams.
J. sci. Instrum., Vol. 35, No. 5, 164-6 (May, 1958).

Double differentiation of the ion beam in a mass spectrometer is shown to have the same effect on peak shape as reduction to zero width of the inlet and exit slits. When this differentiation is performed by modulation of the accelerating voltage, increase of the modulating amplitude results in effective control of the width of both inlet and exit slits making the spectrometer more versatile since its sensitivity and resolving power are easily controlled. Differentiation by an odd number of times enables the centre of a singlet peak to be located with greater speed and accuracy, thus improving the mass measurements made with the spectrometer.
A.

DISCHARGE TUBES. IONIZATION. THERMIONICS

537.542

3192. CONSTRUCTION OF A PROTON SOURCE WITH LOW ARC VOLTAGES. D.Porte.
C.R. Acad. Sci. (Paris), Vol. 245, No. 25, 2233-6 (Dec. 16, 1957). In French.

Describes an ion source basically of the Penning type, but using a hot filament as electron source. Characteristics are shown graphically. Beam currents approach 11 mA total (17% protons if hydrogen used). The source pressure appears to be ~ 10^{-3} mm Hg and a canal of 5 mm length, 5 mm diameter, is mentioned.
J.D.Craggs

537.542

3193. DETERMINATION OF THE PARAMETERS OF PLASMA IN INERT GASES. Yu.M.Kagan, T.Ya.Kal'vinova and I.S.Raudanen.
Vestnik Leningrad. Univ. Ser. Fiz. Khim. No. 3 (1957) No. 16, 41-3. In Russian.

The experiments were carried out using argon and helium. From measurements taken by various methods in the positive column of the discharge it was possible to determine and compare for each the electron concentrations and electron gas temperature.
C.R.S.Manders

537.562

3194. DISCHARGES IN HYDROGEN AT THE ION CYCLOTRON FREQUENCY. A.W.Bright and K.Ramanathan.
Nature (London), Vol. 180, 1468-9 (Dec. 28, 1957).

Experiments are described using hydrogen discharges (~ 0.1 mm Hg pressure) at high frequencies (4 to 5.5 Mc/s) with a magnetic field established over the region of the discharge tube. Frequency-voltage characteristics are shown and support the suggestion that power absorption takes place selectively at the ion cyclotron frequency.
J.D.Craggs

537.562

3195. ABSOLUTE ENERGY TO PRODUCE AN ION PAIR BY BETA PARTICLES FROM S^{35}. W.P.Jesse and J.Sadauskis.
Phys. Rev., Vol. 107, No. 3, 766-71 (Aug. 1, 1957).

The absolute average energy W_β necessary to form an ion pair in nitrogen, ethylene and ethane was determined for S^{35} beta particles by the use of a sample assayed in a 4π counter. The total number of ions produced per second for each gas was determined by a measurement of total ionization in a chamber. The average energy per beta particle was calculated from the known shape of the distribution curve for S^{35}. Corrected values of W_β were found to be 35.3, 26.2 and 24.7 eV/ion pair for N_2, C_2H_4, and C_2H_6 respectively. These values yield a corresponding value for air of 34.1 eV/ion pair. All these are in excellent agreement with values previously predicted from relative beta- and alpha-ray measurements in various gases. A.

537.564 : 534.222.2

3196. ELECTRICAL CONDUCTIVITY OF THERMALLY IONIZED AIR PRODUCED IN A SHOCK TUBE. L.Lamb and Shao-Chi Lin.
J. appl. Phys., Vol. 28, No. 7, 754-9 (July, 1957).

The electrical conductivity of shock-heated air at equilibrium temperature from 3500° to 6200°K, and at densities of the order of 0.01 N.T.P., were measured, using the shock wave-magnetic field interaction technique reported by Lin, Resler and Kantrowitz (Abstr. 2830/1955). The experimental results indicated that the ionization process builds up quickly behind the shock front, and that the measured conductivity agrees quite well with calculated values based on the equilibrium degree of ionization, the electron diffusion cross-sections for the molecular species available in the literature, and on a theoretical estimate of the scattering cross-sections for oxygen and nitrogen atoms by Hammerling, Shine and Kivel (Abstr. 3185 /1958) based on the Hartree potential with appropriate exchange and polarization terms. A.

537.564 : 535.338.334

3197. SHIELDING CORRECTION TO THE ELECTRICAL MICROFIELD IN A PLASMA AND TO HOLTSMARK'S THEORY OF LINE BROADENING. H.Hoffman and O.Theimer.
Astrophys. J., Vol. 127, No. 2, 477-86 (March, 1958).

The probability distribution for the electrical microfield in a plasma, is calculated by Markoff's method. The mutual shielding of positive and negative charges is formally handled by means of the Debye–Hückel theory for strong electrolytes. The shielding effect is found to produce strong deviations from the original Holtsmark distribution, e.g. a strong shift of the maximum toward weak fields and a reduction of the half-width of the distribution. These effects influence the shape of spectral lines as seriously as does the time-dependence of the microfield. A.

537.564 : 538.561

3198. NON-LINEAR EFFECTS IN ELECTRON PLASMAS. P.A.Sturrock.
Proc. Roy. Soc. A, Vol. 242, 277-99 (Nov. 5, 1957).

In this investigation of non-linear effects in electron plasmas, the complications of finite boundaries, external fields, non-zero temperature, multi-stream flow and collisions are ignored. Non-linear effects are studied by a perturbation process, the method of variation of parameters, which yields the dominant effects in weakly excited plasmas. The effects fall into three groups: the excitation of harmonics; coherent interaction; and incoherent interaction. "Coherent" interaction represents all effects which do not result in a redistribution of energy in wave-number space. Such effects, which arise also in the familiar theory of electron plasmas at non-zero temperature, may be summarized by a dispersion relation. The principal aim of this work has been to study the incoherent interaction which is responsible for spectral decay, that is for the redistribution of energy in wave-number space — the breakdown of organized large-scale motion into disorganized small-scale motion. It is found that, to a certain stage of approximation, purely one-dimensional spectra are unique in exhibiting no spectral decay. The decay of a certain spectrum which is almost one-dimensional may be followed analytically and leads to the following result: plasma oscillations which initially have depth of modulation D and are collimated within an angle ϵ tend to isotropy in $(4\epsilon D^2)^{-1}$ plasma periods. This effect may be attributed to a "plasma viscosity" with coefficient $\frac{1}{8}\omega_p^{-1}\langle v^2\rangle$. The incoherent interaction between plasma oscillations and transverse (non-divergent) motion may be interpreted as viscosity or as

a scattering process, depending upon the relative scales of the components. The effects studied in this paper may be interpreted as the result of collisions between plasmons; this interpretation illuminates the problem of spectral decay and suggests that the rate of decay of a one-dimensional spectrum is proportional to D^4. Estimates of the damping of plasma oscillations by the mechanism of spectral decay are compared with the results of certain experiments. A.

537.564 : 538.3

3199. ON THE DYNAMICS OF A BOUNDED PLASMA IN AN EXTERNAL FIELD. L.M.Kovrizhnykh.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 72-6 (1957). In Russian.

Some problems relating to the dynamics of a quasi-neutral plasma formation situated in the field of a plane electromagnetic wave are considered. The method of successive approximations is employed. It is shown that within the limits of the assumptions underlying the analysis, a plasma bunch tends to spread out. A.

537.564 : 530.162

3200. QUANTUM KINETIC EQUATION FOR A PLASMA WITH CORRELATION TAKEN INTO ACCOUNT.
Yu.L.Klimontovich and S.V.Temko.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 132-4 (1957). In Russian.

A quantum kinetic equation has been obtained for a system of particles possessing Coulomb interaction. The equation differs from the well-known quantum kinetic equation in that correlation of the mutual positions of the charged particles has been taken into account. A.

537.564

3201. ON THE EFFECTIVE FIELD IN A PLASMA.
B.B.Kadomtsev.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 151-7 (1957). In Russian.

The Bogolyubov equations for the "partial distribution functions" are employed to compute the effective field acting on charged particles in a plasma. It is shown that the effective field differs from the mean field by a small quantity of the order of 1/N, where N is the number of particles within a sphere whose radius is equal to the Debye radius. The result also holds in the presence of a magnetic field. A.

537.564 : 537.533.8

3202. INVERSION OF TEMPERATURE DEPENDENCE OF INTENSITY OF FRAGMENT LINES IN MOLECULAR MASS SPECTRUM. G.D.Tantsyrev and V.L.Tal'roze.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 5, 802-3 (1957). In Russian.

Describes briefly an experiment in which temperature dependence of intensity of lines of ionization fragments of n-heptane obtained by bombardment with electrons of energies near the appearance potentials, is investigated. Includes graphs of relative intensity of lines of $C_5H_{11}^+$, $C_4H_9^+$ and $C_3H_7^+$ for electrons of 30 eV, 17 eV and 13 eV in each case. Approximately straight lines obtained in all cases show the increase of temperature coefficient of relative intensity with the decrease of electron energy, reaching zero value and eventually changing sign (as shown for two heavier ions). Theoretical interpretation follows. J.M.Zarzycki

537.564

3203. MEASUREMENT OF THE CROSS-SECTION OF ELECTRON CAPTURE BY SINGLY AND DOUBLY CHARGED IONS IN THEIR OWN GASES. I.P.Flaks and E.S.Solov'ev.
Zh. tekh. Fiz., Vol. 28, No. 3, 599-61 (1958). In Russian.

The effective electron capture cross-sections were measured for single (3-30 keV) and doubly (6-60 keV) charged ions of Ne, A, Kr and Xe on single collisions with atoms of their own gases.

537.564

3204. DETERMINATION OF THE CROSS-SECTION OF CAPTURE OF ONE AND TWO ELECTRONS ON SINGLE COLLISIONS OF DOUBLY CHARGED IONS WITH [FOREIGN] GAS ATOMS.
I.P.Flaks and E.S.Solov'ev.
Zh. tekh. Fiz., Vol. 28, No. 3, 612-22 (1958). In Russian.

The cross-sections were measured for 6-60 keV Ne^{2+}, A^{2+}, Kr^{2+} and Xe^{2+} ions in foreign inert gases (e.g. Xe^{2+} in A).

537.581 : 621.385.032.213

3205. ON THE CAUSE OF THE ANOMALOUS FLICKER EFFECT.
W.W.Lindemann and A.van der Ziel.
J. appl. Phys., Vol. 28, No. 4, 448-51 (April, 1957).

This paper extends earlier work by Johnson and Donal on the anomalous flicker effect, observed in tubes with a W cathode under space-charge limited condition, and attributed to positive ions emitted by the cathode. This extension involves the observation of the individual current pulses causing the effect, and the measurement of the flicker effect noise spectrum over a wide frequency range. The results indicate that these pulses are due to sudden bursts of about 10^4 positive ions emitted by the cathode in less than 1 μsec and trapped in the space charge for many μsec. The trapping time of the ions is determined from the shape of the pulses and from the noise spectrum, and the results are found to agree. An experiment that verifies directly that the effect is caused by positive ions, also shows the way to eliminate the effect. A discussion of the nature of these sudden bursts is offered and various mechanisms for the observed decay of the pulses are presented. A.

537.583 : 621.385.032.213.13

3206. A SINTERED NICKEL MATRIX CATHODE. R.W.Fane.
Brit. J. appl. Phys., Vol. 9, No. 4, 149-53 (April, 1958).

A study of a cathode containing alkaline earth carbonates and boron has shown that lives of at least 8000 hr may be obtained at d.c. current densities in excess of 0.5 A/cm². The cathode also exhibits good pulse emission properties. Processing schedules and operating temperatures are similar to those of a normal oxide-coated cathode. Experiments carried out in an attempt to elucidate the mechanism of operation are described. A.

537.583 : 539.219

3207. THERMIONIC EMISSION FROM ORDERING BINARY ALLOYS. K.F.Voitsekhovskii.
Fiz. Metallov i Metallovedenie, Vol. 5, No. 1, 3-7 (1957).
In Russian.

A generalized Richardson equation is derived, taking into account the interaction of the electron gas with the lattice. The Richardson constant and the effective mass of the electrons are shown to depend on the degree of long-range order and on the concentrations of the components of the alloy. A discontinuity is predicted at the ordering temperature in the curve of thermionic current v. temperature. It is also predicted that in non-cubic crystals the thermionic current will depend on the lattice direction. A list of binary alloys is appended for which the ordering temperature is high enough to give measurable effects. A.F.Brown

537.583 : 537.311.33

3208. THERMIONIC AND SEMICONDUCTING PROPERTIES OF [Ag]–Cs_2O, Ag, Cs. J.E.Davey.
J. appl. Phys., Vol. 28, No. 9, 1031-4 (Sept., 1957).

Thermionic emission measurements were carried out on [Ag]–Cs_2O, Ag, Cs layers in a state of near maximum thermionic yield. The data were plotted according to the Fowler equation to determine thermionic work functions; an average value of 0.83 eV was obtained. However, cooling the layers, below ambient, to temperatures of −40°C, results in an increase of work function of approximately 0.3 eV. Photoelectric emission measurements on these same layers yield an average photoelectric work function of 1.06 eV. Conductivity measurements on Cs_2O, Ag, Cs layers are linear between 100° and −70°C; and an activation energy of ~0.1 eV was determined from data in this temperature range. Conductivity measurements on Cs_2O layers containing no reduced Ag exhibit changes in slope similar to the thermionic data. Activation energies computed from above the break in conductivity data are ~0.25 eV. Cooling the layers to −70°C and below results in increases of activation energy of ~0.1 eV. A.

537.583 : 545.1 : 621.385.032.213

3209. THERMIONIC EMISSION OF THORIATED TUNGSTEN.
P.Schneider.
J. chem. Phys., Vol. 28, No. 4, 675-82 (April, 1958).

Methods were developed for quantitative chemical analysis of those constituents of thoriated tungsten filaments, both uncarbonized and carbonized, which are significant for thermionic emission. Sensitivity was adequate for analysis of an individual filament, therefore the composition of each filament could be correlated with both its thermionic performance and the method of preparation. These correlations are given and the chemical constitution for favourable thermionic results is stated. A.

COSMIC RAYS

537.591 : 523.164.32

ORIGIN OF COSMIC RAYS ASSOCIATED WITH SOLAR FLARES. See Abstr. 2736

537.591.15 : 539.1.07

LARGE SCINTILLATOR FOR OBSERVATION OF COSMIC RAYS. See Abstr. 2438

537.591.15

3210. INTERPRETATION OF COSMIC RAY JETS OBSERVED IN PHOTOGRAPHIC EMULSIONS.
I.A.Ivanovskaya and D.S.Chernavsky.
Nuclear Phys., Vol. 4, No. 1, 29-38 (Aug., 1957).

Showers produced in photographic emulsions by high-energy nucleons (10^{10}-10^{12} eV) — the so-called "jets" — are analysed in the present paper. The analysis is based on Fermi's statistical theory extended to the case of interaction between a nucleon and nucleus. It is shown that the main features of these showers can be explained without assuming the existence of two different classes of interactions as hitherto has been done. A.

537.591.15

3211. OBSERVATIONS ON EXTENSIVE AIR SHOWERS. V. THE SIZE SPECTRUM OF SHOWERS CONTAINING 3×10^6-3×10^8 PARTICLES. T.E.Cranshaw, J.de Beer, W.Galbraith and N.A.Porter.
Phil. Mag. (Eighth Ser.), Vol. 3, 377-83 (April, 1958).

For Pt IV see Abstr. 221 (1958). A lattice arrangement of G.M. counters has been used to measure the size spectrum of showers containing 3×10^6-3×10^8 particles. In this region, a power law distribution is found,

$$J(\geq N) = 9.5 \times 10^{-5}(10^6/N)^{1.88 \pm 0.15}\ m^{-2}.hr^{-1}.ster^{-1}.$$

An independent method of measuring the number of particles in the showers gave good agreement with these figures. A.

537.591.15

3212. MEASUREMENTS ON EXTENSIVE AIR SHOWERS AT MOUNTAIN ALTITUDES AT THE GEOMAGNETIC EQUATOR.
B.Jongejans and F.Schurink.
Physica, Vol. 23, No. 10, 977-86 (Oct., 1957).

Counter measurements on extensive air showers were performed at an atmospheric depth of 600 $g.cm^{-2}$ and 700 $g.cm^{-2}$ in the Peruvian Andes, corresponding to respectively 4540 m and 3250 m altitude. Three and sixfold coincidences obtained from counter arrays with different sensitive area were compared. The coefficient g of the inverse power law differential spectrum relating the relative occurrence of a shower to its density was determined. A deviation from the generally accepted theory is found, the constant g varying from 2.27 ± 0.04 to 2.48 ± 0.03 depending on its method of determination. The extension of the set-up used for obtaining these values of g varied from 1.6 to 3 m. Results obtained with a different set-up (distances up to 100 m) are also given, g increasing from 2.5 ± 0.1 to 3.2 ± 0.2 when the extension of the set-up was increased from 5 to 98 m. The absorption lengths obtained from these experiments show a decrease from 138 ± 5 $g.cm^{-2}$ to 45 ± 3 $g.cm^{-2}$ with increasing shower size. A.

537.591.15

3213. INCONSISTENCY BETWEEN THE THEORETICAL AND EXPERIMENTAL δ-SHOWER FREQUENCIES AT HIGH ENERGIES.
P.S.Chikin.
Zh. eksper. teor. Fiz., Vol. 33, No. 1(7), 56-8 (1957). In Russian.

The data on frequency of high-energy δ-electron production by cosmic-ray μ-mesons are classified. Small underground ionization bursts are computed. All the data point to a contradiction between theory and experiment at energies $\geq 5 \times 10^8$ eV. A.

537.591.5

3214. EFFECTIVE MAGNETIC MERIDIAN FOR COSMIC RAYS.
J.R.Storey, A.G.Fenton and K.G.McCracken.
Nature (London), Vol. 181, 34 (Jan. 4, 1958).

A determination of the "cosmic ray meridian" (defined as the line on the earth's surface along which the rate of change of cosmic ray intensity is greatest) through Melbourne was made with an airborne neutron intensity monitor. The magnetic declination at Melbourne is 10° E of N, the geomagnetic meridian 9.5° E of N, while the meridian of the dipole, rotated 45° to the west, is 14.5° E of N. The bearing of the cosmic ray meridian was found to be 10° ± 4° E of N. This result suggests that the "rotated dipole" theory of the observed distribution of cosmic rays over the earth's surface may be wrong. P.Rothwell

537.591.5 : 523.75

3215. EXTRA-ATMOSPHERIC COSMIC RAY DOSAGE DURING THE LARGE SOLAR FLARE OF 23 FEBRUARY 1956.
H.J.Schaefer.
Science, Vol. 127, 186-7 (Jan. 24, 1958).

For a geomagnetic cut-off latitude of 52°, with an integral extra-atmospheric flare-dose of ~ 1.5 rad units, the polar region dosage from primary protons would have been just below the danger level. Other ionizing radiations would have increased the level significantly. E.J.Burge

537.591.8 : 539.12

3216. CROSS-SECTION FOR INELASTIC PROTON–PROTON INTERACTION FOR PROTON ENERGIES EXCEEDING 7 BeV.
K.I.Alekseeva and N.L.Grigorov.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 4, 593-6 (1957). In Russian.

Measurements are carried out using a system of counters at an altitude of 20-25 km with protons of mean energy of the order of 20 BeV. The cross-section was measured by two methods: (1) by the change in shower production in Pb upon insertion of material containing hydrogen, (2) by directly measuring the number of electron-nuclear showers from paraffin and graphite. A result of 32 ± 10 millibarns was obtained. G.E.Brown

537.591.8 : 539.17

3217. ON THE FORMATION OF THE ELECTRON–PHOTON COMPONENT IN THE INTERACTION BETWEEN COSMIC-RAY PARTICLES OF ENERGIES EXCEEDING 10^{11} eV AND BERYLLIUM NUCLEI. L.T.Baradzeĭ, V.I.Rubtsov, Yu.A.Smorodin, M.V.Solov'ev, B.V.Tolkachev and Z.I.Tulinova.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 17-20 (1957). In Russian.

Four electron–nuclear shower events produced by cosmic-ray particles of energy above 10^{11} eV interacting with beryllium nuclei in a cloud chamber are discussed. The energy transferred to π^0-mesons in the interactions is determined. Large fluctuations in the π^0-meson energy were detected. One of the photographs is an example of an interaction in which π^0-mesons are apparently not generated. A.

MAGNETISM

538.082 : 550.38

3218. A NUCLEAR MAGNETOMETER.
G.S.Waters and P.D.Francis.
J. sci. Instrum., Vol. 35, No. 3, 88-93 (March, 1958).

The basic principles of the nuclear free precession magnetometer are briefly described, and full details given of the coils, switching circuits and transistorized amplifying equipment of such a magnetometer. Accuracy of absolute measurement of the earth's total field is ± 10 μG, and even better, when only relative measurements are required. Setting-up of the instrument, which requires no calibration, and taking a reading takes only a few seconds. Suggestions are made for possible further applications of the free precession technique. A.

538.113/.114

3219. NARROWING EFFECT OF DIPOLE FORCES ON INHOMOGENEOUSLY BROADENED LINES.
S.Geschwind and A.M.Clogston.
Phys. Rev., Vol. 108, No. 1, 49-53 (Oct. 1, 1957).

Under the proper circumstances dipole forces can decrease an inhomogeneous broadening of a magnetic resonance line. The necessary condition is that the magnetization of the material by very much greater than the inhomogeneity, and is therefore most easily observed in ferromagnetic materials. Experiments are described in which this narrowing effect was observed in manganese ferrite and yttrium iron garnet. The theory of this effect is discussed for the two cases in which the spatial period of the inhomogeneity is large compared to atomic distances and either (I) short compared to sample size or (II) comparable to sample size. Applications to line broadening in paramagnets and polycrystalline ferrites, and to the low-temperature peak in single crystals of yttrium iron garnet and manganese ferrites, are discussed. A.

538.114

3220. INTERPRETATION OF THE VARIATIONS OF THE FERRIMAGNETIC RESONANCE FIELD OF GADOLINIUM GARNET WITH TEMPERATURE. J.Paulevé.
C.R. Acad. Sci. (Paris), Vol. 245, No. 19, 1604-7 (Nov. 4, 1957). In French.

Discusses previous results of the author (see Abstr. 7215/1957) and of Calhoun et al (Abstr. 230/1958) for the resonance field near the compensation temperature. A fairly satisfactory explanation is given in terms of the author's model for gadolinium garnet. D.J.Oliver

538.114

3221. ANISOTROPY THEORY OF FERROMAGNETIC MONOCRYSTALS. N.A.Potapkov.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 2, 269-72 (1958). In Russian.

The anisotropy matrix for a postulated monocrystal is set up and the interaction Hamiltonian is formulated for Bloch spin-waves

propagating in the given lattice. The energy and polarization vector are shown to form a covariant tensor with the crystal matrix.

J.W.Gardner

538.114

3222. RELATIONS BETWEEN DIFFERENT MODES OF ACQUISITION OF THE REMANENT MAGNETIZATION OF FERROMAGNETIC PARTICLES. E.P.Wohlfarth.
J. appl. Phys., Vol. 29, No. 3, 595-6 (March, 1958).

The relations, valid under stated conditions, are between the remanence acquired in a given field and that acquired after d.c. or a.c. demagnetization in the same field. A relation for the "remanence coercivity" is also derived. E.P.Wohlfarth

538.114

3223. NOTES ON THE GROUND STATE OF ANTIFERROMAGNETISM. O.Nagai.
J. Phys. Soc. Japan, Vol. 12, No. 8, 978 (Aug., 1957).

Extends previous work (Abstr. 1437/1957) studying the onset of antiferromagnetism, predicted by the anisotropic exchange Hamiltonian by including in part the effects of correlation among neighbouring spins in the manner used by Marshall (Abstr. 9759-60/1966). As in the initial work, it is found that the number of antiparallel pairs of spins decreases with increasing coordination number, in contradiction to the results of spin wave-theory. It is concluded that the introduction of correlation in the present manner does not necessarily lead to a better approximation. D.J.Oliver

538.114

3224. A THERMODYNAMICAL THEORY OF "WEAK" FERROMAGNETISM IN ANTIFERROMAGNETICS. I.E.Dzyaloshinskii.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1547-62 (1957). In Russian.

A thermodynamical theory of "weak" ferromagnetism of Fe_2O_3 and $MnCO_3$ and $CoCO_3$ is developed on the basis of Landau's theory of phase transitions of the second kind. It is shown that "weak" ferromagnetism is due to relativistic spin–lattice and magnetic dipole interactions. A strong dependence of the properties of such "weak" ferromagnetic substances on the magnetic symmetry of the crystal is noted. Their behaviour in an external magnetic field is studied. A.

538.122.07 : 621.3.013.22

3225. PREPARATION OF PERMANENT THREE-DIMENSIONAL VIEWS OF MAGNETIC FIELDS. L.F.Crump.
J. appl. Phys., Vol. 28, No. 5, 530-1 (May, 1957).

A method has been developed for obtaining a permanent three-dimensional view of the flux pattern of a magnetic field by suspending microscopic, magnetically-responsive particles in a transparent plastic solution, applying the magnetic force to form the particles into a definitive pattern of the field, and allowing the plastic to set. After the plastic solidifies, the specimen may be cut and polished for observation and later study or reference. A variation of this technique provides for the preparation of views on transparent plates. The process lends itself readily to the study and resolution of problems in magnetics encountered in research and development. It also has possible applications in the fabrication of magnetic and electronic components. A.

538.122.07 : 537.543 : 621.317.444

3226. A MAGNETIC GAUGE UTILIZING THE MAGNETRON EFFECT. W.Fulop.
J. sci. Instrum., Vol. 35, No. 2, 52-5 (Feb., 1958).

The cut-off region of a magnetron diode is shown to be an accurate, though relative measure of the magnetic field. This magnetron effect is utilized to calibrate a sub-miniature diode to serve as a fluxmeter. Only simple ancillary apparatus is required and accuracies greater than 1% are easily attainable. Conditions which such a fluxmeter has to fulfil for satisfactory operation are stated, and experiments prove these to be met. A.

538.22

3227. MAGNETIC PROPERTIES AND THE STRUCTURE OF METALS. W.Sucksmith.
Brit. J. appl. Phys., Suppl. No. 6 (Physics of non-destructive testing), S24-S27 (1957).

There are many physical properties which are important both from the theoretical and experimental points of view in the study of ferromagnetic metals and their alloys. Some of these are of a more fundamental nature and are related to field-independent characteristics such as saturation intensity and Curie point. They may also affect the behaviour of ferromagnetic materials in low fields. Others which are concerned primarily with such low field properties as permeability, magnetostriction, and domain structure are dealt with. These relationships are examined in order to appreciate the extent to which magnetic properties can be used as a means of detecting variations in the structure and properties of magnetic materials. The report concludes with a consideration of newer developments in magnetism which may have application in future. A.

538.22 : 537.311.31

3228. THE MAGNETIC SUSCEPTIBILITY AND ELECTRICAL RESISTIVITY OF SOME TRANSITION METAL SILICIDES. D.A.Robins.
Phil. Mag. (Eighth Ser.), Vol. 3, 313-27 (April, 1958).

Sintered samples have been prepared of a number of silicides formed by the group IVa, Va and VIa transition metals and silicon. Magnetic susceptibility measurements were made at room temperature and 500°C and the electrical resistivity and temperature coefficient of resistivity determined for the range 20°C to 120°C. The results are discussed in relation to the type of bonding present in these compounds and it is shown that the transition-metal silicides are essentially metallic in character. A.

538.22

3229. LOW-TEMPERATURE MAGNETIC STUDIES OF URANIUM HYDRIDE, URANIUM DEUTERIDE, AND URANIUM DIOXIDE. W.E.Henry.
Phys. Rev., Vol. 109, No. 6, 1976-80 (March 15, 1958).

A study of magnetization as a function of temperature and magnetic field was carried out for the above compounds at temperatures from 300°K to 1.3°K and in magnetic fields from 60 000 gauss down to zero field. The apparent saturation magnetization for the samples of beta-uranium hydride used is 1.18 ± 0.03 Bohr magnetons per atom of uranium and for one sample of uranium deuteride is 0.98 ± 0.03 Bohr magneton per atom of uranium. The magnetic moment of uranium dioxide, limited by what may be antiferromagnetic ordering, is about 0.025 Bohr magneton per atom of uranium at 35 000 gauss and 1.3°K. This result makes possible corrections for the moments of UH_3 and UD_3 on the basis of a known oxygen content or an estimate of the oxide impurity on the basis of apparent saturation. A high zero-field remanent magnetization (over 50% of the saturation magnetization for a spherical sample) is observed, attesting to the pronounced magnetic hardness of beta-uranium hydride. Analytic expressions have been worked out for magnetization as a function of temperature for zero magnetic field and 11 500 gauss, leading to a paramagnetic θ of 180°K and a ferromagnetic θ of 168°K. An estimate of 2×10^6 gauss is made for the molecular field in UO_2. A.

538.22.08 : 621.317.44

3230. A DEVICE FOR STUDYING MAGNETIC ANISOTROPY. B.B.Timofeev.
Elektrichestvo, 1957, No. 5, 72-4. In Russian.

Based on an observation previously made by the author (Izv. Akad. Nauk,SSSR, Otdel. tekh. Nauk, No. 3, 1956 and Abstr. 1390B/1956; Elektrichestvo, 1955, No. 10, 53-6) a vertical probe is applied to the surface of a large slab of material under investigation. By this means an alternating current is fed into the material. Attached to the vertical rod by a loose collar is a small coil in the form of a sector and containing a large number of turns. The connections to the coil are taken to an amplifier on the Y-plates of a c.r.o. The X-deflection has a voltage proportional to the current in the probe. It will be observed from the screen of the c.r.o. when the net excitation in the sector coil is zero. An appendix analyses the situation and shows how the method defines the regions of different permeability and the lines along which the maxima and minima occur. To overcome the lack of uniformity of the surface an improved version is also described in which four sector coils, each covering 90°, are used. S.C.Dunn

538.221

3231. INTERPRETATION OF THE MAGNETIC PROPERTIES OF YTTRIUM GARNET WITH Al^{3+}, Ga^{3+} AND Cr^{3+} IONS SUBSTITUTED FOR Fe^{3+} IONS. G.Villers and J.Loriers.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 2033-6 (Dec. 4, 1957). In French.

Reports results of measurements of the variation with x of the saturation magnetization of the substances $(5-x)Fe_2O_3 \cdot xM_2O_3 \cdot 3Y_2O_3$, $(0 \leq x \leq 1)$; for M = Cr p_B increases with x up to 0.5. The results are discussed on the basis of Néel's theory. The Curie temperatures were also measured; they decrease linearly with increasing x, extrapolating to zero at x = 5. E.P.Wohlfarth

538.221

3232. TIME DECREASE OF PERMEABILITY IN IRON. A.J.Bosman, P.E.Brommer, H.J.van Daal and G.W.Rathenau.
Physica, Vol. 23, No. 11, 989-1000 (Nov., 1957).

The time decrease of initial permeability was studied for iron

containing interstitial nitrogen. The activation energy for nitrogen diffusion is derived from this. A method for resolving the different relaxation times is given. Besides the well known relaxation time for elementary jumps of nitrogen atoms, relaxation is observed at times which are about 1000 times larger. Also satellites of the main relaxation are found and explained. It is shown that the time decrease is influenced by the way of demagnetization preceding the relaxation experiment. An explanation of these effects is offered. A.

538.221 : 538.632

3233. THE SPONTANEOUS HALL EFFECT IN FERROMAGNETICS. II. J.Smit.
Physica, Vol. 24, No. 1, 39-51 (Jan., 1958).

For Pt I, see Abstr. 3008 (1956). It is shown that the spontaneous part of the Hall effect arising from the spontaneous magnetization is caused by skew scattering of the magnetized conduction electrons (in this case the 3d-electrons) due to their transverse polarization induced by spin-orbit interaction, which acts as an impact parameter in the collision process. The problem could be approximately solved for scattering on an impurity atom by converting it into that of the scattering on a vortex-like perturbing centre. The order of magnitude of the calculated Hall angle agrees with the experimental one ($\approx 10^{-2}$). It is shown quite generally that for lattice vibration scattering the Hall effect should be proportional to the square of the resistivity, as has been found experimentally for pure iron and nickel. A.

538.221

3234. THE MAGNETIC PROPERTIES OF IRON SELENIDE SINGLE CRYSTALS. K.Hirakawa.
J. Phys. Soc. Japan, Vol. 12, No. 8, 929-38 (Aug., 1957).

Large single crystals of Fe_7Se_8 and Fe_3Se_4 were prepared, and their magnetic properties below the Curie point were investigated by a torque magnetometer. The results obtained on Fe_7Se_8 at room temperature show similar characteristics to that of natural pyrrhotite (Fe_7S_8), i.e. the crystals can be magnetized only in the c-plane. As the temperature is lowered, however, the c-axis becomes the direction of easy magnetization. This change in direction seems to occur gradually. In the case of Fe_3Se_4, such a change in direction of easy magnetization does not take place. The obtained saturation magnetizations for Fe_7Se_8 and Fe_3Se_4 are respectively 68 and 80 G at the liquid air temperature. A.

538.221 : 621.318.12

3235. MAGNESIUM-COPPER-MANGANESE-ALUMINUM FERRITES FOR MICROWAVE APPLICATIONS. L.G.Van Uitert.
J. appl. Phys., Vol. 28, No. 3, 320-2 (March, 1957).

Magnesium-manganese-aluminium ferrites prepared by dry pressing techniques are usually fired in the temperature range between 1350° and 1400°C for extended periods of time, to obtain samples having high relative densities. When about 10% of the Mg in such a system is replaced by Cu, as in the series $Mg_{0.9}Cu_{0.1}Al_XFe_{1.75-X}Mn_{0.01}O_{4\pm}$, it is possible to obtain samples with high relative densities and d.c. resistivities by firing in the 1250° to 1300°C range. Such materials are suitable for microwave applications. The preparation of ferrites of this type is discussed and data are presented on the saturation inductions, Curie temperatures, densities and d.c. resistivities. A.

538.221

3236. EFFECTS OF ANNEALING ON THE SATURATION INDUCTION OF FERRITES CONTAINING NICKEL AND/OR COPPER. L.G.Van Uitert.
J. appl. Phys., Vol. 28, No. 4, 478-81 (April, 1957).

The equilibrium distribution of Cu between octahedral and tetrahedral sites in the ferrites varies appreciably with temperature. The rate at which these ions approach their equilibrium distribution at a fixed temperature, after quenching from a higher temperature, is much greater for the slightly reduced materials. Previously unreported deviations from a smooth variation of saturation induction with annealing temperature were observed in ferrites containing Ni and/or Cu, which were prepared to achieve a high degree of homogeneity and hence to be relatively free from defects. A.

538.221

3237. INFLUENCE OF COPPER AND VANADIUM ON THE SINTERING OF MAGNESIUM-TYPE FERRITES. L.C.F.Blackman.
J. appl. Phys., Vol. 28, No. 12, 1511-12 (Dec., 1957).

The variation with firing temperature of the densities of some mixed Mg ferrites depends on the furnace atmosphere (N_2, O_2) in a way which may be interpreted in terms of structural defects. E.P.Wohlfarth

538.221 : 621.318.12

3238. SOME MAGNETIC PROPERTIES OF Mn—Mg FERRITE WITH RECTANGULAR HYSTERESIS LOOP.
Z.Funatogawa, N.Miyata and H.Sando.
Sci. Rep. Yokohama Nat. Univ. I, No. 6, 14-20 (Sept., 1957).

Dependence of magnetic properties — saturation and remanent magnetization, magnetostriction and the relative value of magnetic crystalline anisotropy energy — of Mn—Mg ferrite (MnO 33 mol.%, MgO 31 mol.%, Fe_2O_3 36 mol.%) on heat treatment was investigated. An intimate relation was found between rectangularity of hysteresis curve and magnetostriction; specimens, cooled slowly in a furnace, with high remanent magnetization showed very small longitudinal magnetostriction especially in the region of the initial part of magnetization, contrary to those quenched from high temperature with low remanent magnetization and rather large magnetostriction. Saturation magnetization decreased with decrease of quenching temperature, probably due to the change of distribution of Mg-ions in the crystal lattice. A.

538.221 : 537.226.2

COMPLEX PERMEABILITY OF FERRITES. See Abstr. 3065

538.221 : 537.226.2

PERMEABILITY OF MnZn FERRITES. See Abstr. 3068

538.221 : 621.318.1

3239. MAGNETIC DOMAIN PATTERNS ON THIN FILMS.
H.J.Williams and R.C.Sherwood.
J. appl. Phys., Vol. 28, No. 5, 548-55 (May, 1957).

Magnetic domain patterns were observed on evaporated films of Fe, Co, Ni, and several different alloys of these elements. The films were deposited in the presence of a magnetic field to establish a uniaxial direction of easy magnetization. It was found that the direction of easy magnetization, in films of all compositions, could be changed by re-heat-treating them in a magnetic field with a new orientation. This is of special interest because bulk specimens of the elements do not respond to heat treatment in a magnetic field. Nucleation and growth of domains were observed for fields applied at various angles to the uniaxial direction of easy magnetization in some of the films. Patterns were obtained on films ranging in thickness from approximately 50 to 12 000 A. Domain walls in films ranging from 50 to 500 A in thickness tend to aggregate in pairs. A.

538.221 : 539.234

3240. INVESTIGATIONS OF THE MAGNETIC PROPERTIES OF EVAPORATED IRON FILMS BY MEANS OF THE FARADAY EFFECT. L.Reimer.
Z. Phys., Vol. 148, No. 4, 527-32 (1957). In German.

A continuation of previous work (Abstr. 537/1957). Measurements of the coercive force by this method (checked ballistically in a few cases) are reported for Fe films from 20 to 800 A thick, evaporated onto glass and to rocksalt at 20°, 200° and 350°C. The results at the higher temperatures show a coercivity maximum at about 100 A. The crystallite character of the films was investigated by electron microscopy, and crystallites of dimensions about 700 A were observed for a film evaporated at 350°C. The coercivity is believed to depend on the single domain character of the crystallites in the film, if this below a certain thickness. Electron diffraction measurements are also reported. E.P.Wohlfarth

538.221

3241. FERROMAGNETIC RESONANCE AT U.H.F. IN THIN FILMS. R.H.Kingston and P.E.Tannenwald.
J. appl. Phys., Vol. 29, No. 2, 232-3 (Feb., 1958).

Previous observations (Abstr. 3443/1957) were extended to 80-20 Permalloy films of thickness 5600 A at frequencies between 2×10^3 and 4×10^3 Mc/s. The magnetic field was applied in the plane of the film both parallel and perpendicular to the easy axis. In both cases the resonance frequency varied with the applied field in the expected manner. Line widths were ~ 200 Oe, the spin-spin relaxation time was $\sim 5 \times 10^{-10}$ sec, and the spin-lattice relaxation time, obtained using pulsed r.f. sources was 2×10^{-9} sec. D.J.Oliver

538.221

3242. FURTHER INVESTIGATIONS ON THE NUCLEAR RELAXATION IN AN ANTIFERROMAGNETIC SINGLE CRYSTAL. G.E.G.Hardeman, N.J.Poulis, W.van der Lugt and W.P.A.Hass.
Physica, Vol. 23, No. 10, 907-21 (Sept., 1957).

The proton spin relaxation in the antiferromagnetic single crystal of $CuCl_2.2H_2O$ was investigated. The spin lattice relaxation time t_1 was measured for different strengths and orientations of the external magnetic field H_0. The dependence of t_1 on H_0 was predicted

theoretically in a previous paper (Abstr. 3010/1956). In order to compare the results with this theoretical dependence, the behaviour of the total magnetic field H_t acting on a given proton was analysed for different external field vectors H_0. The internal magnetic field at the position of the proton, due to the antiferromagnetic lattice, was determined accurately with the help of a separate resonance experiment. From the results on t_1 and the analysis of H_t it is concluded that the thermal fluctuations of the Cu magnetic moments are oriented predominantly along the direction of their time average magnetic moment. However, the thermal fluctuations perpendicular to the time average magnetic moments are not negligible. The determination of the temperature dependence of t_1 was extended down to 0.86°K. It proves that the empirical relation: $t_1 = \text{const.}\ T^{-7}$, as found in the previous measurements, is still valid down to this temperature. A.

538.221

3243. NUCLEAR MAGNETIC RESONANCE AND RELAXATION IN ZERO FIELD AND NEAR THE THRESHOLD FIELD.
N.J.Poulis, G.E.G.Hardeman, W.van der Lugt and W.P.A.Hass.
Physica, Vol. 24, No. 4, 280-8 (April, 1958).

As a result of previous measurements (see preceding abstract), proton magnetic resonance in antiferromagnetic copper chloride was expected to occur also in zero external field. Due to the interaction between the two protons in one crystalline water two resonance lines were observed. The proton—proton distance in a crystalline water was calculated from the frequency distance between these two resonance lines. The calculated distance is in good agreement with the results of the measurements of Levy and Peterson using neutron diffraction. It can be concluded that the magnetic moments of the Cu ions cannot be considered as mathematical dipoles located in the centre of the Cu ion (or Cl ion). The magnetization of a sublattice was measured as a function of temperature. The proton spin—lattice relaxation time t_1 was measured in zero field as a function of temperature. The temperature dependence of t_1 is even more pronounced than in a finite external field. Measurements of t_1 as a function of the external field strength were carried out up to the threshold field. A.

538.221 : 536.631

NUCLEAR MAGNETIC INTERACTION IN AN ANTIFERROMAGNETIC CRYSTAL. See Abstr. 3052

538.222/.224 : 537.311.33

3244. MAGNETIC SUSCEPTIBILITY OF GERMANIUM.
R.Bowers.
Phys. Rev., Vol. 108, No. 3, 683-9 (Nov. 1, 1957).

The magnetic susceptibility of highly doped Ge was measured between 300° and 1.3°K. The contribution of the carriers to the susceptibility was derived from the data. Most of the measurements concerned electrons occupying unbound states in the conduction band. The observed conduction-electron susceptibility was compared with theoretical estimates based on the effective-mass values given by cyclotron-resonance experiments. The results support a 4-ellipsoid model of n-Ge. No appreciable change in the effective masses was observed between room temperature and 1.3°K. No evidence was found for any substantial change in the curvature of the conduction band for energies up to 0.08 eV above the band minimum. This finding contradicts certain conclusions of Stevens et al. (Abstr. 489/1956). An explanation for the disagreement is proposed. Measurements were made of the spin susceptibility of quasi-bound states of electrons and holes in Ge at a carrier density near $6 \times 10^{16}/\text{cm}^3$. In each case, the spin susceptibility was found to be almost independent of temperature. It is concluded that there is strong exchange coupling between neighbouring impurity centres at this concentration. The susceptibility of high-purity Ge was measured, and found to be independent of temperature below 60°K. A.

538.222

3245. PRINCIPAL MAGNETIC SUSCEPTIBILITIES OF COBALTOUS BROMIDE AND IODIDE.
H.Bizette, C.Terrier and B.Tsaï.
C.R. Acad. Sci. (Paris), Vol. 246, No. 2, 250-2 (Jan. 13, 1958).
In French.

Reports results of susceptibility measurements up to room temperature; for $CoBr_2$ susceptibility maxima were observed at 19°K and for CoI_2 parallel to the hexagonal axis at 3°K.
E.P.Wohlfarth

538.222

3246. MAGNETIC AND ELECTRIC PROPERTIES OF VANADIUM TRIOXIDE. S.Teranishi and K.Tarama.
J. chem. Phys., Vol. 27, No. 5, 1217-18 (Nov., 1957).

Reports results of susceptibility measurements between 0° and 620° C and in fields up to 6000 oersted of non-stoichiometric V_2O_3 specimens; Néel temperatures between 258° and 385° C and p_B values between 1.95 and 3.04 were observed for the different specimens. Thermoelectric measurements are also reported.
E.P.Wohlfarth

538.222

3247. MAGNETIC SUSCEPTIBILITIES OF VANADATES OF NEODYMIUM AND PRASEODYMIUM. R.C.Vickery and A.Klann.
J. chem. Phys., Vol. 27, No. 5, 1219-20 (Nov., 1957).

Reports results of room temperature susceptibility measurements of MVO_3 prepared under different conditions of firing temperature and atmosphere; for M = Nd the results obey approximately an additivity rule, but for M = Pr the observed are larger than the calculated values. E.P.Wohlfarth

538.222

3248. PREPARATION AND MAGNETIC PROPERTIES OF PYROCHLORE-TYPE TITANATES OF NEODYMIUM AND PRASEODYMIUM. R.C.Vickery and A.Klann.
J. chem. Phys., Vol. 27, No. 5, 1220-1 (Nov., 1957).

Results similar to those reported in the preceding abstract were obtained for MTi_2O_7. E.P.Wohlfarth

538.222

3249. THE MAGNETIC SUSCEPTIBILITY OF OXYGEN IN A CLATHRATE COMPOUND. II.
H.Meyer, M.C.M.O'Brien and J.H.Van Vleck.
Proc. Roy. Soc. A , Vol. 243, 414-21 (Jan. 14, 1958).

It is shown that previous measurements (Pt I, Abstr. 9391/1954) on the magnetic susceptibility of oxygen in a clathrate compound can be explained if it is assumed that the molecule, instead of being completely free as previously assumed, is subject to a potential $V_0(1-\cos 2\theta)$ with $V_0/k = 32°K$. θ is the angle between the figure axis of the molecule and the c-axis of the crystal. The susceptibility measurements were extended down to 0.25°K and showed good agreement with the theory. A.

538.222 : 539.152.2

3250. RELAXATION TIMES IN NUCLEAR RESONANCE OF A MOVING SAMPLE. K.Antonowicz.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 5, No. 11, 1069-72 (1957).

A tube containing the sample was passed through the receiver coil at various speeds and the maximum of the absorption signal was measured as a function of the r.f. field strength. The analysis shows that both T_1 and T_2 can be obtained from the results. The technique is valuable where T_1 is long. D.J.Oliver

538.222 : 537.311.33

3251. PARAMAGNETIC RESONANCE OF SILICOCARBON.
Y.Sugiura and G.M.Hatoyama.
J. Phys. Soc. Japan, Vol. 12, No. 7, 837 (July, 1957).

Microwave resonance absorption at 1.25 cm was observed in silicon resins, made semiconducting by heating, in vacuum, in the range from 600° to 1000°C. The number of unpaired electrons on the C atoms was estimated from the absorption curves as a function of treatment temperature. A value of $g = 2.0027 \pm 0.0005$ was derived.
R.Stratton

538.222 : 536.48

3252. PARAMAGNETIC RELAXATION IN Co—Fe NH_4-TUTTON SALTS. T.Haseda.
Physica, Vol. 24, No. 2, 93-100 (Feb., 1958).

Paramagnetic relaxation in $CoNH_4$-Tutton salt in which some of Co^{+2} ions are replaced by Fe^{+2} ions, was measured at liquid helium temperatures. The anomalous field dependency of ρ_{SL} found in pure cobaltous salt, was modified as the Fe^{+2} concentration increases. Interactions between Co^{+2} and Fe^{+2} ions are suggested to have an important role in the relaxation process. A.

538.222 : 536.48

3253. PARAMAGNETIC RELAXATION IN SOME DILUTED AND UNDILUTED CHROMIUM, COPPER AND MANGANESE SALTS AT VERY LOW TEMPERATURES.
L.C.van der Marel, J.van den Broek and C.J.Gorter.
Physica, Vol. 24, No. 2, 101-15 (Feb., 1958).

Measurements were made on some diluted chromium potassium

alums and on diluted and undiluted manganese ammonium and copper potassium Tutton salts. The salts were placed in a magnetic field, consisting of a constant part and an alternating part of low frequency. The results on the highly diluted salts and on the undiluted manganese Tutton salt may in a good approximation be described by Casimir and Du Pré's formulae with one relaxation time. Deteriorated samples deviate largely from these formulae. The relaxation parameters of the manganese salts have about the same dependence on temperature, magnetic field and concentration of the magnetic ions as those of the iron alums; this is not quite the case with the parameters of the other samples examined. In the discussion a provisional explanation of the data of this paper and earlier papers is presented.

A.

538.222 : 541.144

3254. PARAMAGNETIC RESONANCE ABSORPTION IN IODINE. K.D.Bowers, R.A.Kamper and C.D.Lustig.
Proc. Phys. Soc. B, Vol. 70, Pt 12, 1176-7 (Dec., 1957).

The apparatus described in Abstr. 3448 (1957) was used to study the process of photodissociation of I_2 vapour, and the paramagnetic resonance spectrum of free I^{127} atoms. Relative values of electron g-factor to free spin and proton g-factors are given to two parts per million. J.Hawgood

538.24

3255. DOMAIN CHANGES DURING LONGITUDINAL MAGNETIZATION OF IRON WHISKERS. G.G.Scott and R.V.Coleman.
J. appl. Phys., Vol. 28, No. 12, 1512-13 (Dec., 1957).

The simple domain structure (one 180° wall + closure domain) can be altered, so as to produce a cube-shaped closure domain at the centre, by transverse magnetization. Longitudinal magnetization in fields up to 200 Oe distorts and finally removes this closure domain as saturation is reached. The end effects are more complicated. E.P.Wohlfarth

538.245

3256. THE VARIATION OF THE MAGNETIZATION NEAR SATURATION OF PURE POLYCRYSTALLINE IRON AND NICKEL. H.Danan.
C.R. Acad. Sci. (Paris), Vol. 246, No. 1, 73-6 (Jan. 6, 1958).
In French.

Reports results of precision measurements at 15° C and in fields up to 2.5×10^4 oersted. The saturation magnetization values, obtained by extrapolation, are: Fe, 217.0 ± 0.2 e.m.u.gram^{-1}; Ni, 55.05 ± 0.05 e.m.u.gram^{-1}. E.P.Wohlfarth

538.245

3257. CALCULATION OF THE MAGNETIZATION OF A UNIAXIAL FERRITE AT LOW TEMPERATURES. E.N.Yakovlev.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 4, 699-701 (1957). In Russian.

The magnetization is calculated using an approximate method of boson second quantization. The resulting formulae, showing the decrease of magnetization with temperature for weak fields and the opposite for strong fields, are discussed physically.

S.F.Edwards

538.27 : 538.652

3258. THEORY OF THE WIEDEMANN EFFECT. M.Yamamoto.
J. Phys. Soc. Japan, Vol. 12, No. 8, 981-2 (Aug., 1957).

Under the combined action of a circular and longitudinal magnetic field, a ferromagnetic experiences a twist. A theory of the effect applicable to cylindrical rod specimens is given. D.J.Oliver

ELECTROMAGNETISM. ELECTRODYNAMICS

538.3 : 519.2

3259. CLASSICAL ELECTRODYNAMICS AS A DISTRIBUTION THEORY. II. J.G.Taylor.
Proc. Cambridge Phil. Soc., Vol. 54, Pt 2, 258-64 (April, 1958).

For previous part see Abstr. 3033 (1956). A definition of the energy and momentum of the field lying in a space-like surface is given, and it is shown that from this four-vector it is possible to derive the usual equation of conservation of total energy and momentum. A.

538.3

3260. MAXWELLIAN ELECTRODYNAMICS AND HUYGHENS' PRINCIPLE. G.Zin.
R.C. Accad. Naz. Lincei, Vol. 23, No. 6, 421-7 (Dec., 1957).
In Italian.

If curl $\vec{K} + m\vec{K} = 0$, the value of $\vec{K}$ at a point P inside a surface S is expressed in terms of integrals over S of $e^{\pm imr}(\vec{n} \times \vec{K})/r$. This result is used to represent the electromagnetic intensities at a point P, in a field of pulsatance ω, in terms of a distribution of electric and magnetic dipoles over a surface enclosing P.

R.A.Newing

538.3 : 532.5

3261. ELLIPSOIDAL EQUILIBRIUM FIGURE FOR AN ELECTRICALLY CONDUCTING FLUID MASS ROTATING UNIFORMLY IN A MAGNETIC FIELD WHICH VARIES WITH TIME. C.Agostinelli.
R.C.Accad. Naz. Lincei, Vol. 23, No. 6, 409-14 (Dec., 1957).
In Italian.

The components of the magnetic field are linear in the x and y coordinates, the coefficients being periodic in time. The fluid is a uniform liquid rotating about the z-axis. R.A.Newing

538.3 : 537.564

3262. ELECTRODYNAMICAL ACCELERATION OF PLASMA BUNCHES. L.A.Artsimovich, S.Yu.Luk'yanov, I.M.Podgornyĭ and S.A.Chuvatin.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 3-8 (1957). In Russian.

An electrodynamical method for acceleration of plasma bunches is proposed. Results of preliminary experiments are described. The data are in qualitative agreement with the elementary theory of the phenomenon. A.

538.3 : 532.5

3263. THE STRUCTURE OF STRONG COLLISION-FREE HYDROMAGNETIC WAVES. J.H.Adlam and J.E.Allen.
Phil. Mag. (Eighth Ser.), Vol. 3, 448-55 (May, 1958).

A theoretical study has been made of the structure of strong "hydromagnetic" waves which are propagated, across a magnetic field, in a low-density plasma, where collisions can be neglected. Under these conditions the ions are accelerated in the direction of propagation and then brought to rest again. The thickness of the wave is determined by the characteristic distance $\sqrt{(mc^2/4\pi ne^2)}$ and the wave velocity lies between the Alfvén speed and twice the Alfvén speed. A

538.3 : 532.59

3264. ON THE INTERACTION BETWEEN GRAVITATIONAL-CAPILLARY AND MAGNETOHYDRODYNAMICAL WAVES. M.F.Shirokov.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 67-71 (1957). In Russian.

The uniqueness theorem for solutions of the hydrodynamical equations for an incompressible strongly conducting ideal liquid is proved. Walen's exact solution for the case when gravitational and capillary forces act on the liquid is shown to be valid. Relations for the conditions of stability, penetration depth etc., are derived for potential and vortex harmonic waves. In the case of potential motion of the liquid the current density in the surface layer is found to be exactly zero. A.

538.3 : 532.5 : 534.222.2

HYDROMAGNETIC BEHAVIOUR OF SHOCK WAVES. See Abstr. 2902

ELECTROMAGNETIC WAVES AND OSCILLATORS

538.561

3265. ON THE PROBLEM OF THE SPECTRUM OF AN ELECTRON SYSTEM IN AN EXTERNAL FIELD. G.G.Taluts and S.A.Shulyat'ev.
Fiz. Metallov i Metallovedenie, Vol. 5, No. 2, 373-4 (1958).
In Russian.

Determination of the frequency of oscillations of an electron plasma in a constant uniform electric field using the method of collective variables (D.N.Zubarev, Abstr. 754/1955).

538.561 : 621.375.9 : 621.317.34

3266. NOISE TEMPERATURE MEASUREMENT ON A SOLID STATE MASER. A.L.McWhorter, J.W.Meyer and P.D.Strum.
Phys. Rev., Vol. 108, No. 6, 1642-4 (Dec. 15, 1957).

An upper limit of 20° K was measured for the noise temperature of a three-level maser with $K_3Co_{0.995}Cr_{0.005}(CN)_6$ as the substance.

he measurement was made by comparison with an argon discharge
oise tube, by means of a Dicke radiometer. The noise from such a
evice should come from spontaneous transitions only and amount to
°K. The maser was operated at 1.25°K, but the uncertainties due
the measurement of population ratio, the calibration of the argon
scharge and the noise generated by the input line allowed only an
pper limit to be placed on the noise temperature. D.Walsh

538.561 : 621.375.9

267. A PARAMETRIC ELECTRON BEAM AMPLIFIER.
.J.Bridges.
roc. Inst.Radio Engrs, Vol. 46, No. 2, 494-5 (Feb., 1958).

An electron beam device similar in principle to the ferrite
mplifier proposed by Suhl (Abstr. 6363/1957) has been made. It
onsists of double-gap cavity similar to a floating drift-tube
lystron (at 4150 Mc/s). The beam loading susceptance is modulat-
d by a preceding cavity that bunches the beam at the "pump" fre-
uency (8300 Mc/s). A gain of 20 dB has been observed. It is point-
d out that the noise figure should be low since the noise from the
eam induced at the two gaps can be in antiphase. D.Walsh

538.561 : 621.375.9

268. A TRAVELING-WAVE FERROMAGNETIC AMPLIFIER.
.K.Tien and H.Suhl.
roc. Inst. Radio Engrs, Vol. 46, No. 4, 700-6 (April, 1958).

A theory of a ferromagnetic travelling-wave amplifier of para-
netric type is presented. Amplification of signal power in the form
f growing waves is obtained in a propagating structure which is
artially or totally embedded in a ferromagnetic medium. The
tructure, in one of its possible forms, possesses two propagating
odes: one of the modes is excited by a signal at the input end, and
he other is used as an idling circuit. The structure should also
upport a travelling wave supplied by a local oscillator which
rovides, through the motion of the magnetization, a time-varying
oupling between the two propagating modes. The problem is essen-
ally that of two coupled transmission lines with a time-dependent
oupling coefficient. Optimum conditions for amplification are
erived. A structure consisting of two pairs of parallel wires is
alculated to illustrate the general principles. A.

538.561 : 621.375.9

269. OBSERVATIONS OF NON-LINEAR MASER PHENOMENA.
.H.Higa.
ev. sci. Instrum., Vol. 28, No. 9, 726-7 (Sept., 1957).

Two TE_{011} cavities resonating at the 3,3 line of NH_3 were
ascaded along the same beam and provided with separate wave guides,
n order to observe their signals independently. If the first cavity
as sufficiently detuned, the second cavity suddenly oscillated at
he centre frequency, since more molecules enter the second cavity
ith diminished probability of induced emission, and, at the critical
oint, the thermo-electric field in this cavity starts oscillations at
he optimum frequency. These oscillations are amplitude modulated,
nd the difference frequency can be heterodyned from both cavities,
r obtained directly from the signal from the second cavity. Differ-
nce frequencies of 2 to 5 kc/s (increasing with beam intensity) were
easured. The maser can thus amplify signals while oscillating,
.e. it can be used simultaneously as a frequency standard and as a
ignal amplifier, provided that the signal frequency is within the
aser bandwidth. J.J.Phipps

538.566

270. CONCERNING LEWIS' DIFFRACTION PATTERN IN THE
LANE OF A HALF SCREEN. C.L.Andrews.
. appl. Phys., Vol. 28, No. 9, 1070 (Sept., 1957).
See Abstr. 7557/1956.

538.566

3271. SECONDARY DIFFRACTION OF ELECTROMAGNETIC
VAVES ON A DISK. P.Ya.Ufimtsev.
Zh. tekh. Fiz., Vol. 28, No. 3, 583-91 (1958). In Russian.

538.566.3 : 621.396.8

272. REMARKS ON THE CONNECTION BETWEEN MODE
HEORY AND RAY THEORY. H.Bremmer.
uovo Cimento Suppl. (Ser. 10), Vol. 4, No. 4, 1552-8 (1956).

The propagation of radio waves via the ionosphere is considered
athematically, on the basis of a simplified model of the earth and
s atmosphere. It is shown how a single expression can be derived
or the amplitude of the Hertzian vector, which incorporates both the
ay-theory treatment and the method of expansion in eigenfunctions.
G.M.Brown

NUCLEAR AND ATOMIC PHYSICS
APPARATUS. PARTICLE DETECTORS

539.1.07

3273. GUARDED-FIELD THIMBLE IONIZATION CHAMBERS.
L.A.W.Kemp and B.Barber.
Nature (London), Vol. 180, 1116-17 (Nov. 23, 1957).

Design data are given for the form of guarded field chamber previously described (Abstr. 2349/1957), in which a cylindrical conducting wall is divided into several annular sections. Plots are given of ionization loss (0.1 to 5.0%) as a function of chamber dimensions. J.D.Craggs

539.1.07 : 621.317.723

3274. AN AUTOMATIC QUARTZ-FIBRE ELECTROMETER.
M.C.B.Russell and J.Leng.
J. sci. Instrum., Vol. 35, No. 4, 134-8 (April, 1958).

A quartz-fibre electrometer with ancillary equipment is described, whereby an average rate of change of potential may be determined with probable errors of about ±0.2 mV in the change of potential, and ±0.02 sec in the measurement of time. An instrument for automatic recording of β-activity within the range 0.04 to 30 μc is described in detail with experimental results. A.

539.1.07

3275. ON THE ROSENBLUM SPARK COUNTER IN AIR.
L.Daddi and L.De Franceschi.
Nuovo Cimento, Vol. 7, No. 6, 895-7 (March 16, 1958).

Gives details of the characteristics of a spark counter with rod–wire geometry. The variation of counting efficiency with angle of incidence of the α-particles and voltage–counting rate curves are given. There is a brief general discussion of the mechanism. J.D.Craggs

539.1.07 : 535.376

3276. NEW SCINTILLATORS FOR THE DETECTION OF THERMAL NEUTRONS. G.Thielens.
Appl. sci. Res. B, Vol. 7, No. 1, 87-8 (1958).

Four luminescent organo-boron solid compounds were prepared and tested. Only α-naphthylboric acid produced the expected results as a usable thermal neutron scintillator, with a detection efficiency of about 80% for a 2 mm thick polycrystalline specimen.
J.B.Birks

539.1.07

3277. A TOTAL-ABSORPTION ČERENKOV COUNTER FOR PHOTONS OF ABOUT 100 MeV ENERGY.
J.Moffatt and M.W.Stringfellow.
J. sci. Instrum., Vol. 35, No. 1, 18-20 (Jan., 1958).

The counter uses a cylinder crystal of thallous chloride 12 cm long and 9.3 cm in diameter viewed by a photomultiplier tube, and is capable of giving pulses of up to 3 V in height without serious departure from linearity. The pulse height resolution for 78 MeV photons is 34%, and both the mean pulse-height and resolution remain constant to within 5% over an entrance aperture 5 cm in diameter. The performance of the counter is discussed in some detail, and it appears that the resolution is limited principally by strong absorption of u.v. light in the crystal. A.

539.1.07

3278. LIQUID HYDROGEN BUBBLE CHAMBER EXPANDED BY A PISTON IN THE LIQUID. E.M.Bolze, T.W.Morris, D.C.Rahm, R.R.Rau, R.P.Shutt, A.M.Thorndike and W.L.Whittemore.
Rev. sci. Instrum., Vol. 29, No. 4, 297-9 (April, 1958).

A liquid hydrogen bubble chamber with useful volume $6\frac{1}{4} \times 2\frac{3}{4} \times 3$ inches has been built which is expanded by a piston operating in the liquid hydrogen. Temperature control is provided by regulating the pressure in the hydrogen reservoir. Satisfactory tracks were obtained with maximum expansion ratio of 3%, expansion time of about 5 msec, and chamber temperatures from 25.3 to above 27°K. Photographs were taken with time delay between particles passing through chamber and light flash of 0.05 to 2.0 msec. A.

539.1.07

3279. EFFECT OF pH OF AMIDOL DEVELOPERS ON THE BACKGROUND (γ) OF NUCLEAR EMULSIONS.
J.Bermond and M.Scherer.
C.R. Acad. Sci. (Paris), Vol. 246, No. 3, 407-9 (Jan. 20, 1958).
In French.

For 400 μ G5 emulsions and pH > 6, the average background den-

sity increased rapidly with pH, and decreased with depth in emulsion. The range of pH studied was 4 to 7.1. E.J.Burge

539.1.07

3280. A GAS TARGET AND NUCLEAR PLATE CAMERA.
D.L.Booth, R.S.Hill, F.V.Price, D.Roaf and G.L.Salmon.
J. sci. Instrum., Vol. 35, No. 1, 24-6 (Jan., 1958).

A windowless gas target capable of maintaining a pressure of up to 2 mm Hg was constructed to determine the differential cross-section of charged particle reactions. Targets of this type were used to examine (d,p) and (d,α) reactions in the range 15 keV to 1 MeV. A.

539.1.07 : 621.374.32

3281. MILLIMICROSECOND TIME-TO-PULSE-HEIGHT CONVERTER USING AN R.F.VERNIER.
R.L.Chase and W.A.Higinbotham.
Rev. sci. Instrum., Vol. 28, No. 6, 448-51 (June, 1957).

An r.f. vernier technique is used to facilitate the timing of an event with respect to the phase of a high-frequency clock. The event starts an oscillator whose frequency differs only slightly from that of the reference clock. The phase of the low-frequency beat note is used as an index of the phase of the clock at the time the event occurred. The system is particularly adaptable to studying fast neutron velocity distributions when the neutron pulses are produced at high repetition rates. It uses a minimum of fast circuit elements, is useful over almost the entire period between pulses at 20 Mc/s and higher, and gives unambiguous results. The performance with random pulses and with neutron groups was studied with a 100-channel pulse-height analyser. A.

539.1.07

3282. IMPROVED N.M.R. SPECTROMETER.
J.M.Mays, H.R.Moore and R.G.Shulman.
Rev. sci. Instrum., Vol. 29, No. 4, 300-2 (April, 1958).

An improved Pound–Knight–Watkins spectrometer is described. It has an arrangement which reduces frequency fluctuations by a factor of 5-10 at 30 Mc/s. The spectrometer is capable of stable operation, with sensitive metering, down to an r.f. level of 0.01 V across the sample coil, an improvement of almost an order of magnitude. The instrument also allows direct measurement of the derivative of χ', the real part of the susceptibility of the sample. A.

ELEMENTARY PARTICLES

539.12

3283. THE ENERGY LOSS OF FAST CHARGED PARTICLES. III.
D.A.Tidman.
Nuclear Physics, Vol. 4, No. 2, 257-70 (Aug.[2], 1957).

For previous part see Abstr. 7163 (1957). Formulae previously obtained are investigated numerically and their predictions compared with experiment for the case of oxygen. Good agreement is obtained. A.

539.12

3284. BREMSSTRAHLUNG OF ULTRA-RELATIVISTIC PARTICLES IN A CENTRAL FIELD. A.G.Sitenko.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1505-8 (1957). In Russian.

Bremsstrahlung of an ultra-relativistic particle of spin ½ in an arbitrary field with central symmetry is considered. A general relation between the bremsstrahlung cross-section and scattering cross-section for the relativistic particles is established. A.

539.12 : 535.43 : 530.16

SCATTERING OF PARTICLES AND KRAMERS–KRONIG DISPERSION RELATIONS. See Abstr. 2812

539.12 : 530.145

TWO-COMPONENT THEORY OF THE NEUTRINO AND K-MESON DECAYS COMPRISING TWO NEUTRINOS. See Abstr. 2777

539.12

3285. MAGNETIC MOMENT OF THE ELECTRON. A.Petermann.
Nuclear Physics, Vol. 3, No. 5, 689-90 (July, 1957).

Existing calculations (Karplus and Kroll, Abstr. 3776/1950) of the fourth-order term were checked and revised with sufficient accuracy to compare with experiment. The new result is consistent with experiment. J.C.Taylor

539.12

3286. FOURTH ORDER MAGNETIC MOMENT OF THE ELECTRON. A.Petermann.
Nuclear Physics, Vol. 5, No. 4, 677-83 (March, 1958).

A more complete account is given of an estimation, by rigorous upper and lower bounds, of the fourth-order magnetic moment of the electron, which has already been published by the author. The method is illustrated for one typical term. Then the results of a more elaborate estimation are given. In the terminology used by Karplus and Kroll (Abstr. 3776/1950), the term symbolized by the diagram IIc is found to satisfy

$$\mu(\mathrm{IIc}) = (-0.60 \pm 0.11)(\alpha^3/\pi^3) - (\alpha^3/2\pi^3)\log(\lambda^2/m^2),$$

in contradiction with the value

$$-3.18(\alpha^3/\pi^3) - (\alpha^3/2\pi^3)\log(\lambda^2/m^2),$$

given by the previous authors. It has been found that the other terms are not in disagreement with Karplus and Kroll values. If one accepts them, then the total fourth-order moment amounts to $\mu^{(4)} = (-0.39 \pm 0.11)(\alpha^3/\pi^3)$. It is noted that this new value increases the Lamb shift by (0.82 ± 0.03) Mc/s and brings the fine-structure constant to $1/\alpha = 137.0384$. A.

539.12

3287. ON THE SPATIAL DISTRIBUTION FUNCTION OF PARTICLES IN AN ELECTRON–PHOTON SHOWER.
V.V.Guzhavin and I.P.Ivanenko.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 6, 1089-92 (1957).
In Russian.

A continuation of earlier work (Abstr. 8701/1957). W.O.Lock

539.12 : 537.591.15

3288. ENERGY SPECTRUM OF CASCADE ELECTRONS IN LIGHT SUBSTANCES. I.P.Ivanenko.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 135-8 (1957). In Russian.

The energy spectrum of cascade electrons in showers produced by a primary electron or photon in light substances was computed. A short analysis of the numerical results is presented, and possible applications to cosmic rays are indicated. A.

539.12

3289. PRODUCTION OF ELECTRON–POSITRON PAIRS IN COLLISIONS BETWEEN FAST π-MESONS AND NUCLEONS.
E.M.Rabinovich.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1563-6 (1957). In Russian.

The cross-section for pair production in collisions between high-energy π-mesons and nucleons is calculated. A.

539.12 : 530.145

ELECTROMAGNETIC STRUCTURE OF THE NUCLEON. See Abstr. 2785

539.12

3290. APPROXIMATE DISPERSION RELATIONS FOR THE SCATTERING OF NUCLEONS BY NUCLEONS.
V.Z.Blank and I.S.Isaev.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 5, 785-7 (1957). In Russian.

Approximate information that can be obtained without knowledge of nucleon–antinucleon scattering is derived. G.E.Brown

539.12

3291. PROTON–PROTON COLLISION IN HIGH ENERGY.
D.Ito, S.Minami and H.Tanaka.
Nuovo Cimento, Vol. 8, No. 1, 135-46 (April 1, 1958).

The experimental results of the proton–proton collisions at 1.5 GeV and 2.75 GeV by Fowler et al. (Abstr. 701/1957) are analysed in a phenomenological way. It is found then that the partial waves of $l = 2\text{-}5$ and $l = 2\text{-}7$ are mainly responsible for the pion production at 1.5 GeV and 2.75 GeV respectively. Further, from the analysis in such an energy region it is shown that the effective size of the proton is nearly constant [$(0.6\text{-}0.7) \times 10^{-13}$ cm]. A.

539.12

3292. PROTON–PROTON SCATTERING AT MEDIUM-HIGH ENERGIES. A.Hossain.
Pakistan J. sci. industr. Res., Vol. 1, No. 1, 40-4 (Jan., 1958).

An analysis of data up to 32 MeV by established methods (Abstr. 7020/1950, 3300/1952). For a Yukawa potential the corresponding meson mass is calculated to be 318 m_e. E.J.Burge

539.12 : 537.591.6

INELASTIC PROTON–PROTON INTERACTION. See Abstr. 3216

539.12

3293. POLARIZATION IN P–P SCATTERING AT 635 MeV. M.G.Meshcheryakov, S.B.Nurushev and G.D.Stoletov. Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 37-46 (1957). In Russian.

The angular distribution of polarization arising in p–p scattering was studied in the range $11.6 \leq \theta \leq 90.3^0$ (c.m.s.) by means of single and conjugated telescopes of scintillation counters. A proton beam of 635 MeV energy and polarization of 0.58 ± 0.03 was employed. An analysis of the results of measurement of the differential cross-sections $\sigma_0(\theta)$ for elastic scattering of 657 MeV unpolarized protons by protons, was performed on basis of the optical model of p–p scattering with the aim of establishing the nature of interference between the Coulomb and nuclear scattering amplitudes. The polarization data can be satisfactorily approximated by a certain function. Presence of the term $\sin\theta \cos\theta P_4(\cos\theta)$ in that function indicates that triplet F-states play an important role in the scattering. It is found that at 635 MeV the polarization in quasi-elastic p–p scattering on beryllium comprises about 85% of the polarization of protons scattered on hydrogen. A.

539.12

3294. ANTIPROTONS IN NUCLEAR EMULSIONS. A.G.Ekspong, S.Johansson and B.E.Ronne. Nuovo Cimento, Vol. 8, No. 1, 84-91 (April 1, 1958).

In one stack of nuclear emulsions exposed at the Bevatron, Berkeley, 10 events were found and identified as due to antiprotons. The interaction characteristics are analysed and reported. Of special interest is the observation of an elastic collision between an antiproton and a free proton. A.

539.12 : 539.17

3295. INTERACTION OF ANTIPROTONS WITH COMPLEX NUCLEI. A.E.Glassgold. Phys. Rev., Vol. 110, No. 1, 220-5 (April 1, 1958).

The large reaction cross-sections observed for antiproton collisions with complex nuclei may be understood in terms of strong absorption in the diffuse surface of the nucleus. Large values for the real part of the potential are not required. The elastic scattering of antiprotons is also discussed. A.

539.12 : 538.122

3296. ON THE MAGNETIC SCATTERING OF THERMAL NEUTRONS NEAR THE CURIE POINT IN FERROMAGNETICS AND ANTIFERROMAGNETICS. M.A.Krivoglaz. Dokl. Akad. Nauk SSSR, Vol. 118, No. 1, 51-4 (1958). In Russian.

A thermodynamic theory of the anomalous magnetic scattering, which considers the distribution of the Fourier probability component of the magnetic moment and the fluctuations in this component. Differential cross-section formulae are given for different cases. W.O.Lock

539.12

3297. THE SCATTERING OF COLD NEUTRONS BY LIQUID HELIUM. P.A.Egelstaff and H.London. Proc. Roy. Soc. A, Vol. 242, 374-91 (Nov. 5, 1957).

The differential cross-section and the average energy loss of 45^0K neutrons for scattering by liquid helium have been measured at angles of scatter near 0 and 180^0 and for liquid temperatures from 1.6 to 5.2^0K. From these data the second moments of the radial distribution function and the zero-angle cross-sections have been calculated. The latter are close to those given by the theory of density fluctuations in a liquid. The energy transfers cannot be explained in the absence of a liquid model. The backward scattering can be explained as either a free atom process or one in which phonons are excited. Data on the scattering of 45^0K neutrons by the saturated helium vapour at 4.2^0K are given and it is concluded that the moments of the radial distribution function are larger for the gas than the liquid. A.

539.12 : 539.2

SCATTERING OF NEUTRONS BY LEAD. See Abstr. 2640

539.12

3298. FAST NEUTRON ATTENUATION IN GRAPHITE. V.P.Duggal and S.M.Puri. J. appl. Phys., Vol. 29, No. 4, 675-9 (April, 1958).

Spatial distribution of a fast neutron flux was measured experimetnally in graphite (density 1.62 g/cm^3) using threshold radioactivants. For these measurements neutrons were obtained from D–T and D–Be reactions. Assuming the neutron flux to vary as $1/R^2 e^{-R/L}$, the the values of relaxation length L (between 50 cm and 70 cm) obtained with a phosphorous detector from D–T and D–Be neutrons are 23.5 ± 1.5 cm and 19.7 ± 1.0 cm, respectively. It is also seen that fast flux falls off less rapidly than resonance neutron (1.46 eV) flux after about 50 cm in graphite. The spatial distribution of neutrons between the energies 1 MeV to 3 MeV from a plane monoenergetic source of 3 MeV neutrons was also obtained using a Monte Carlo calculation. A.

539.12 : 539.17

NEUTRON YIELD FROM VARIOUS RADON SOURCES. See Abstr. 2568

539.12

3299. THE THEORETICAL ASPECTS OF THE PHYSICS OF THE NEW PARTICLES. G.Morpurgo. Nuovo Cimento Suppl. (Ser. 10), Vol. 5, No. 3, 417-28 (1957). In Italian.

A fairly elementary review mainly concerned with: (a) the success of the Gell-Mann and Nishjima classification scheme; (b) the new questions which have arisen in connection with the problem of the two bosons (τ and θ); the investigation of methods to determine the spins of the new particles; the problem of the weak interactions. G.Martelli

539.12

3300. AN INTRODUCTION TO THE PHYSICS OF THE NEW PARTICLES. C.Franzinetti and G.Morpurgo. Nuovo Cimento Suppl., Vol. 6, No. 2, 469-802 (1957).

A lengthy and fully documented review of the experimental and theoretical position up to March 1957. The article is intended to serve as a guide to research workers entering this field. There are sections devoted to the basic properties (mass, mean life, decay products, etc) of the K-mesons and hyperons, to the theoretical analysis which leads to the concept of strangeness, and to the interactions of the new particles with pions and nucleons, including the formation of hyperfragments. The τ–θ paradox, which led to the discovery of parity non-conservation, is also fully discussed. S.J.Goldsack

539.12 : 530.145

3301. CHIRALITY INVARIANCE AND THE UNIVERSAL FERMI INTERACTION. E.C.G.Sudarshan and R.E.Marshak. Phys. Rev., Vol. 109, No. 5, 1860-2 (March 1, 1958).

A universal V–A Fermi interaction between any two of the pairs of particles np, Λp, $\mu^-\nu$ and $e^-\nu$ is proposed, this form being chosen for chirality invariance. It agrees with present experiments, except for the electron-neutrino correlation in He^6, and the absence of the electron mode in π-decay. $\Xi^-\Lambda$ can be added to the pairs above, but the predicted Ξ^--decay is unsatisfactory. R.J.N.Phillips

539.12

3302. MESONIC PRODUCTION OF MESONS. J.de Oyarzabal. Rev. Mexicana Fís., Vol. 6, No. 4, 153-64 (Oct., 1957). In Spanish.

The cross-sections for the processes $p + \pi^- \rightarrow p + \pi^- + \pi^0$; $p + \pi^- \rightarrow n + \pi^- + \pi^+$; $p + \pi^- \rightarrow n + \pi^0 + \pi^0$; $n + \pi^- \rightarrow n + \pi^- + \pi^0$; and $n + \pi^- \rightarrow p + \pi^- + \pi^-$ are calculated for the cases S(S) (scalar mesons, scalar coupling); S(V); PS(PS); PS(PV). L.Pincherle

539.12 : 539.17

3303. PROBLEM OF THE INTERACTION OF μ-MESONS WITH NUCLEONS. I.S.Shapiro, É.I.Dolinskiĭ and L.D.Blokintsev. Dokl. Akad. Nauk SSSR, Vol. 116, No. 6, 946-8 (1957). In Russian.

The angular distribution of neutrons arising from the capture of a μ-meson in a μ-mesic atom, i.e. in the process

$$\mu^- + p \rightarrow n + \nu$$

is calculated for polarized μ-mesons under the assumption of different variants of lepton–nucleon interaction. G.E.Brown

539.12 : 539.17

3304. CROSS-SECTION FOR THE TRANSFER OF A μ^--MESON FROM A PROTON TO A DEUTERON. S.S.Gershtein. Dokl. Akad. Nauk SSSR, Vol. 117, No. 6, 956-8 (1957). In Russian.

The calculation is described and the results compared with other work in connection with the catalysis of fusion reactions. G.H.Burkhardt

539.12

3305. ON THE INTERACTION BETWEEN μ-MESONS AND NUCLEONS. I.S.Shapiro, E.I.Dolinsky and L.D.Blokhintsev. Nuclear Physics, Vol. 4, No. 2, 273-6 (Aug.[2], 1957).

The angular distribution and longitudinal polarization of neutrons produced in the capture of μ^--mesons by μ-mesohydrogen are computed. A.

539.12 : 530.145

MUON INTERACTION WITH PROTONS. See Abstr. 2789

539.12

3306. RADIATIVE β-DECAY OF THE π-MESON. E.Ferrari.
Nuovo Cimento, Vol. 8, No. 1, 155-9 (April 1, 1958).

The probability of the process $\pi \rightarrow e + \nu + \gamma$ is calculated by means of a cut-off procedure. It is shown that for ST coupling the branching ratio $(\pi \rightarrow e + \nu + \gamma)/(\pi \rightarrow \mu + \nu)$ is practically independent of the cut-off parameter. A.

539.12

3307. $\pi^{\pm} \rightarrow \pi^0 + e^{\pm} + \nu + 8m_e c^2$? E.Feenberg and H.Primakoff.
Phil. Mag. (Eighth Ser.), Vol. 3, 328-33 (April, 1958).

The process $\pi^+ \rightarrow \pi^0 + e^+ + \nu$ has not yet been observed. Estimates of its branching ratio relative to $\pi^+ \rightarrow \mu^+ + \nu$ can be derived: (1) from a phase-space volume argument in conjunction with the available experimental information on π^+ and (assumed analogous) K^+ processes, and (2) from a calculation of the rate of the beta-decay transition between the "π^+" and "π^0" states of a bound nucleon–antinucleon structure. A possible experimental scheme for detection of $\pi^+ \rightarrow \pi^0 + e^+ + \nu$ in the presence of the overwhelmingly more frequent $\pi^+ \rightarrow \mu^+ + \nu$ is outlined. A.

539.12

3308. PRODUCTION OF NEUTRAL π-MESONS BY HIGH ENERGY PROTONS.
Yu.D.Bayukov, M.S.Kozodayev, Yu.D.Prokoshkin and A.A.Tyapkin.
Nuclear Phys., Vol. 4, No. 1, 61-87 (Aug., 1957).

The paper contains the results of some investigations carried out by the authors on the synchrocyclotron of the Institute for Nuclear Problems (Dubna, U.S.S.R.) in 1950-55. A.

539.12

3309. ON A POSSIBILITY OF K-MESON INVESTIGATION.
L.G.Zastavenko, A.L.Liubimov, V.I.Ogievitsky and M.I.Podgoretsky.
Nuclear Phys., Vol. 3, No. 4, 549-52 (June, 1957).

Assuming θ and τ mesons to be different particles, one should expect the neutral τ-meson life-time to be considerably greater than 10^{-10} sec. This can be used in some experiments to determine the differences between θ and τ particles. In the present paper two experiments of this kind are proposed. A.

539.12

3310. ON THE DECAY MODES OF INTERACTING AND NON-INTERACTING K^+-MESONS. B.Bhowmik, D.Evans, D.J.Prowse, F.Anderson, D.Keefe and A.Kernan.
Nuovo Cimento, Vol. 8, No. 1, 147-54 (April 1, 1958).

The decay modes of K^+-mesons inelastically scattered from nuclei in emulsion were determined and it is shown that their relative frequencies are consistent with those obtained for K^+-mesons which have not undergone nuclear interaction. Measurements were also made on a total of 286 decay events with a singly charged secondary with the object of discovering without detection bias, particles decaying in the rare τ' and the $K_{\mu 3}$ modes. A.

539.12

3311. DISPERSION RELATIONS FOR THE SCATTERING OF K-MESONS BY NUCLEONS. M.K.Polivanov.
Dokl. Akad. Nauk SSSR, Vol. 116, No. 6, 943-5 (1957). In Russian.

The relations are given under the assumption that the interaction is of a Yukawa type, $N \leftrightarrow K + Y$, $Y \leftrightarrow N + \bar{K}$. The non-physical region and bound states are considered in detail. G.E.Brown

539.12 : 530.145

K-MESON DECAYS. See Abstr. 2769

539.12

3312. DISPERSION RELATIONS FOR THE DECAY OF THE τ-MESON. E.Corinaldesi.
Nuclear Physics, Vol. 3, No. 5, 649-55 (July, 1957).

The kinematics of the τ-meson decay is formulated so as to make possible the use of dispersion relations for the transition amplitude. A.

539.12 : 539.17

τ^+ MESON DECAY. See Abstr. 2557

539.12

3313. PARITY VIOLATION AND THE POLARIZATION OF NUCLEONS FROM HYPERON DECAY. J.Leitner.
Nuovo Cimento, Vol. 8, No. 1, 68-73 (April 1, 1958).

A general expression for the polarization of nucleons from hyperon decay is obtained. It is shown that this polarization is purely longitudinal in the rest frame of the hyperon. Such longitudinal polarization will have a component transverse to the nucleon momentum in the laboratory system and is thus detectable by means of nuclear scattering. A.

NUCLEUS

539.14

3314. A VARIATIONAL APPROACH TO THE NUCLEAR MANY-BODY PROBLEM. V.J.Emery.
Nuclear Phys., Vol. 6, No. 4, 585-95 (April [2], 1958).

Jastrow's variation method (see Abstr. 6762/1955) is applied to the nuclear many-body problem. It is found that it is necessary to restrict the variation of the trial function in order to obtain reasonable results from the approximation used. Calculations of the properties of nuclear matter are used to investigate the effects of two possible restrictions. The physical justification of the restriction is discussed and a method of generalizing the trial wave-function is given. A.

539.14

3315. IS H^5 PARTICLE STABLE? C.H.Blanchard and R.G.Winter.
Phys. Rev., Vol. 107, No. 3, 774-5 (Aug. 1, 1957).

Rough estimates based on the excited states of neighbouring nuclei suggest that H^5 is either stable against nucleon emission, or unbound by a rather small amount. A.

539.14

3316. MIXING RATIOS OF $2^+ \rightarrow 2^+$ TRANSITIONS IN SOME EVEN NUCLEI. T.Lindqvist and I.Marklund.
Nuclear Physics, Vol. 4, No. 2, 189-205 (Aug. [2], 1957).

Mixing ratios of $2^+ \rightarrow 2^+$ transitions in Se^{76}, Te^{122}, Te^{124} and Os^{186} were measured by means of directional gamma–gamma correlations. Ten other similar cases in even nuclei are summarized. The E2 radiation is dominating, although the amount of M1 radiation is measurable. The transitions investigated are examples of transitions between vibrational states, which according to theory should proceed by pure E2. The presence of M1 might indicate that the wave-functions involved are not pure. The possibility of emission of E0 conversion electrons are discussed. In six cases an upper limit is given for the emission rate. A.

539.14

3317. LEVELS IN Pb^{202} AND Tl^{202} POPULATED FROM 3.62-h Pb^{202m}.
J.A.McDonell, R.Stockendal, C.J.Herrlander and I.Bergström.
Nuclear Phys., Vol. 3, No. 4, 513-40 (June, 1957).

Using beta spectroscopic techniques, conversion electrons of transitions following the decay of 3.62 hr Pb^{202m} were investigated. The previously suggested level sequence in Pb^{202} is unambiguously supported by the results: 0+ (0 keV), 2+ (961.4 keV), 4+ (1383.5 keV), 5– (2041.1 keV) and 9– (2170.7 keV). From the 9– state two gamma-rays of multipolarity E4 (129.3 keV) and E5 (787.2 keV) are emitted. In addition, a very weak E5 transition of energy 547.2 keV between the 9– state and a second 4+ state (1623.8 keV) was observed, as well as an M1 transition of energy 240.3 keV between the two 4+ states. The succession of the 422.1 keV and 961.4 keV transitions was determined by comparing their relative intensities in the decay of Pb^{202m} and Bi^{202}. Except for the 5– level, the similarity between levels in Pb^{202} and Pb^{204} is very striking. The 9– state in Pb^{202} was found to be de-excited also by electron capture (9.7%) to levels in Tl^{202}. The following level sequence is suggested for the Tl branch: 2– (0 keV), 4– (490.4 keV), 7+ (950.2 keV), 6+ (1099.1 keV) and 8+ (1340.1 keV). The 8+ state is de-excited by an M1 transition of energy 389.9 keV, and also by a 241.1 keV E2 transition followed by a 148.9 keV M1 transition. The isomeric 7+ state is de-excited by a 459.8 keV E3 transition and a 490.4 keV E2 transition in cascade. The succession of the 389.9, 459.8 and 490.4 keV transitions is suggested from coincidence measurements. A gamma-ray of energy 335.6 keV and multipolarity M1 (?) may be emitted from an 8+ or 9+ (1675.7 keV) level to the 8+ (1340.1 keV) level. In addition, some weak conversion lines were found, to which no definite assignment could be given. A.

539.14

3318. THE ENERGY LEVELS OF Pb^{206}. M.J.Kearsley.
Nuclear Phys., Vol. 4, No. 1, 157-70 (Aug., 1957).

The energy levels of Pb^{206} are calculated on the shell model, regarding Pb^{208} as two holes in the double closed shell nucleus Pb^{208}. The single-hole energies are derived from data on Pb^{207} and interaction energies are calculated using harmonic-oscillator wave-functions and a Yukawa potential. The lowest seven excited states with energies up to 3 MeV are in good agreement with experiment. A.

539.14

3319. SHELL MODEL INTERPRETATION OF ENERGY LEVELS IN Li^7 AND Be^7. J.B.Marion.
Nuclear Physics, Vol. 4, No. 2, 282-6 (Aug.[2], 1957).

The experimental evidence regarding the energy levels in Li^7 and Be^7 is reviewed and compared with the predictions of the shell model near the LS limit. It is found that the nucleon and α-particle reduced widths strongly favour the 7.45 MeV state in Li^7 and the 7.13 MeV state in Be^7 being the J = 5/2 members of the ^4P multiplets rather than of the ^2F multiplets as previously assumed. None of the available experimental results is inconsistent with this identification. The location and a possible method for detecting the $^2F_{5/2}$ level is discussed. It is also suggested that the broad level structure near 6.5 MeV in Li^7 and Be^7 is not adequately described by the simple model proposed by Lane, and an alternative explanation is presented. A.

539.14

3320. COULOMB EXCITATION OF ROTATIONAL LEVELS IN DYSPROSIUM. N.P.Heydenburg and G.F.Pieper.
Phys. Rev., Vol. 107, No. 5, 1297-9 (Sept. 1, 1957).

The Coulomb excitation of energy levels was investigated in isotopically enriched targets of dysprosium by alpha-particle bombardment. One rotational level was observed in each of the two even-even isotopes Dy^{162} and Dy^{164} with energies of 82 keV and 75 keV and transition probabilities $\epsilon B(E2)$ (in units of $e^2 \times 10^{-48}\,cm^{-4}$) equal to 1.65 and 1.09, respectively. Two rotational levels were excited in the odd-A isotope Dy^{161} with energies 46 keV and 103 keV, with values of $\epsilon B(E2)$ equal to 2.44 and 0.04. Two rotational levels were also observed in the isotope Dy^{163} at 75 keV and 166 keV, having $\epsilon B(E2)$ values of 0.43 and 0.67, respectively. There is also evidence for a 93 keV gamma-ray in Dy^{163} which, from coincidence measurements, appears to be the cascade transition from the second to the first excited level. A.

539.14

3321. ENERGY LEVELS OF POLONIUM-210.
R.W.Hoff and J.M.Hollander.
Phys. Rev., Vol. 109, No. 2, 447-56 (Jan. 15, 1958).

The energy levels of Po^{210} were studied as populated by the electron-capture decay of At^{210}. An experimental level scheme is constructed by using data obtained from conversion electron and gamma-ray measurements made with beta-ray and scintillation spectrometers and coincidence counting techniques. A theory of the energy levels of Po^{210} is developed using the method of Pryce to predict the levels of a nucleus containing two odd protons beyond the double-closed shell from the experimentally known levels of Bi^{209}, the nucleus containing a single odd proton beyond the closed shell. Certain features of the theoretcially predicted level scheme and the experimental level scheme show reasonable agreement. The spin assignment for At^{210} is discussed with respect to the log ft values for its electron capture decay. A.

539.14

3322. ENERGY LEVELS OF LIGHT NUCLEI (Z = 11 to Z = 20). II.
P.M.Endt and C.M.Braams.
Rev. mod. Phys., Vol. 29, No. 4, 683-756 (Oct., 1957).

Article replaces the previous compilation (Abstr. 9505/1954) of Endt and Kluyver. It contains experimental material published up to February 1957 on the energy levels of nuclei from Z = 11 to Z = 20. L.L.Green

539.14 : 539.17

3323. MEASUREMENTS WITH A NEUTRON SPECTROMETER USING SLOWING-DOWN TIME IN LEAD. AN EXCITED LEVEL OF THE He^4 NUCLEUS.
A.A.Bergman, A.I.Isakov, Yu.P.Popov and F.L.Shapiro.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 9-16 (1957). In Russian.

Results of measurement of the energy dependence of the cross-sections for the following reactions are presented: (n,γ) in Fe, Pb and Cl; (n,p) in He^3, N^{14} and Cl; (n,α) in Li^6 and B^{10}. Neutron energies up to 30 keV were employed. It is shown that the cross-section for the B^{10} (n,α) reaction lies below the 1/v law, the deviation being smaller than 5-10%. The deviation of the Li^6 (n,α) cross-section from the 1/v law is even less. It is concluded that an excited level exists in the B^{11} nucleus which possesses an angular momentum $J = 5/2^+$ or $7/2^+$, a neutron resonance energy $E_r \sim 250$ keV and widths $\Gamma_\alpha \sim 400$ and $\Gamma_n \sim 200$ keV. An appreciable deviation of the (n,p) cross-section from the 1/v law was detected which may indicate the existence, in the He^4 nucleus, of an excited level which has one of the two sets of parameters: (1) $J = 1^+$, $-E_r \sim 200$ keV, proton width for an excitation energy equal to the neutron binding energy $\Gamma_{po} \sim 200$ keV, and (2) $J = 0^+$, $-E_r \sim 500$ keV, $\Gamma_{po} \sim 1200$ keV. A.

539.14

3324. THE EFFECT OF QUADRUPOLE RELAXATION ON NUCLEAR MAGNETIC RESONANCE MULTIPLETS. J.A.Pople.
Molecular Physs., Vol. 1, No. 2, 168-74 (April, 1958).

A theory of the broadening of multiplet components in magnetic resonance spectra of coupled nuclei due to electric quadrupole spin–lattice relaxation is presented. It is shown that the broadening of the components of the 1 : 1 : 1 triplet for nuclei of spin ½ coupled to a nucleus of spin 1, is ¾ as great for the outer lines as for the central one, provided that the rate of qudrupole relaxation is not too large. This is in agreement with experimental observations on $N^{14}H_3$. A theory of the line shape of the partly collapsed multiplet at higher rates of quadrupole relaxation is also given. A.

539.14

3325. SPIN ECHOES IN ALTERNATING CURRENT ELECTROLYSIS. D.Geissler and H.Pfeifer.
Z. Naturforsch., Vol. 12a, No. 1, 70-6 (Jan., 1957). In German.

The spin-echo method developed by Hahn (Abstr. 2922/1951) has been modified to the case of periodic field changes. The additional magnetic alternating field causes a decrease of the echo amplitude. Owing to the alternating phase between electrolysis field and high-frequency impulse the echo amplitude is expected to oscillate. Experiments, carried out with a spin-echo spectrometer, are described elsewhere (Exper. Tech. der Phys.); they confirm the theoretical results. J.Jacobs

539.14

3326. RADIATIVE INSTABILITY IN NUCLEAR MAGNETIC RESONANCE EXPERIMENTS. K.V.Vladimirskiĭ.
Zh. éksper. teor. Fiz., Vol. 33, No. 2(8), 532-4 (1957). In Russian.

Using the circuit analogue of nuclear magnetic resonance, the stability is discussed via Bloch's macroscopic equations. S.F.Edwards

539.14 : 535.338.334

THEORY OF EXCHANGE NARROWING OF NUCLEAR MAGNETIC RESONANCE LINES. See Abstr. 2957

RADIOACTIVITY

539.16.08 : 550.9

3327. VARIATION IN CONCENTRATION OF RADIOCARBON WITH TIME AND LOCATION ON EARTH. H.De Vries.
Proc. K. Ned. Akad. Wetensch. B, Vol. 61, No. 2, 94-102 (1958).

Radiocarbon measurements on samples of known age (tree rings) demonstrated that the concentration of radiocarbon in the atmosphere varied considerably in the course of a few centuries and also with location on earth. The variations are of the order of 1%. Evidence is presented that the fluctuations are due to variations in vertical mixing in the ocean which brings old (less active) water in contact with the atmosphere. It is not yet possible to understand the origin of the variations with location on earth. Implications on radiocarbon dating are discussed. A.

539.163

3328. ON THE RADIATION OF POLONIUM 210. M.Ader.
C.R. Acad. Sci. (Paris), Vol. 246, No. 1, 97-8 (Jan. 6, 1958). In French.

A source of artificial Po was found to emit long-range ionizing particles and neutrons with spectra identical with those from natural Po. A.O.Stanesby

539.163

3329. ON THE DECAY OF ^{48}Sc AND ^{48}V. B.van Nooijen, J.Konijn, A.Heyligers, J.F.van der Brugge and A.H.Wapstra.
Physica, Vol. 23, No. 8, 753-66 (Aug., 1957).

The spin assignments of the known levels in Ti^{48} excited in the decay of Sc^{48} and were checked by angular correlation and conversion coefficient measurements. The spin and parity of the 3.24 MeV level were uniquely determined as 4^+. The γ-ray energies were found to be 986 ± 3 (γ_1), 1040 ± 3 (γ_2), 1314 ± 4 (γ_3) and 2253 ± 15 (γ_4) keV, the end points of the electron and positron spectra in Sc^{48} and V^{48} 654 ± 7 and 698 ± 4 keV and the decay energies of these nuclides 3994 ± 9 and 4020 ± 7 keV respectively. The intensity of a possible 940 keV γ-ray suggested by earlier coincidence measurements is found to be smaller than 5%. Positron decay occurs in (55.6 ± 0.8)% of the V^{48} transitions; this value is in agreement with theoretical predictions by Zweifel if no 940 keV γ-ray occurs. The half-life of V^{48} was measured as 16.15 ± 0.17 days. A.

539.163

3330. THE DECAY OF ^{90}Nb. R.K.Sheline.
Physica, Vol. 23, No. 10, 923-42 (Oct., 1957).

Nb^{90} produced by the (p,n) reaction on separated Zr^{90} was studied by scintillation beta and gamma spectroscopic methods. The 14.56 ± 0.05 hr activity emitted positrons with an end point of 1.48 ± 0.03 MeV and photons of 0.0176 ± 0.001, 0.133 ± 0.003, 0.142 ± 0.002, 0.370 ± 0.005, 0.511 ± 0.003, 0.900 ± 0.010, 1.137 ± 0.006, 2.200 ± 0.020, and 2.330 ± 0.010 MeV. Relative intensities of most of the transitions were determined. The anisotropy of the 0.142-1.137 MeV cascade is −0.112 ± 0.046. These measurements together with coincidence measurements are used to assign the following levels (in MeV) and spins in the daughter nucleus Zr^{90} 1.77 (0+), 2.20 (2+), 2.33 (5−), 3.10, 3.47 (6+) and 3.61 (8+). Following the suggestion of Ford, these levels are interpreted as proton levels arising from the ground state configuration $(p_{1/2})^2$ and the two excited state configurations $(g_{9/2})^2$ and $(g_{9/2}\, p_{1/2})$. All states expected from these configurations are observed, with the exception of the $(g_{9/2}\, p_{1/2})_{4-}$ and the $(g_{9/2})^2_{4+}$ states. The relative population of the ground and first excited 0^+ states in the beta decay of Y^{90}, and in the de-excitation of the 2.20 (2+) state in Nb^{90}, indicate that these states are highly mixed $(p_{1/2})^2$ and $(g_{9/2})^2$ states. Other states are shown by a variety of criteria to be relatively pure. A simple method to calculate the half-life of the 1.77 MeV 0 + → 0 + transition in Zr^{90} yields the value 2.0×10^{-9} sec. A.

539.163

3331. FURTHER EXPERIMENTS ON THE DECAY OF ^{202}Tl.
H.C.Hamers, A.Marseille and T.J.de Boer.
Physica, Vol. 23, No. 11, 1056-66 (Nov., 1957).

For previous work see Abstr. 3950 (1956). New investigations concerning the electron capture decay of Tl^{202} resulted in an estimation of the energy of the transition from the ground state of Tl^{202} to the 440 keV excited state of Hg^{202}. With the help of the theoretical results of Brysk and Rose this transition energy was found to be 599 ± 5 keV. It appeared that 39% of all the transitions go from ground to ground, it is likely that these transitions are of the unique first forbidden type. A.

539.163.2

3332. ON THE DECAY OF ^{133}Ba.
R.K.Gupta, S.Jha, M.C.Joshi and B.K.Madan.
Nuovo Cimento, Vol. 8, No. 1, 48-59 (April 1, 1958).

The results of β-ray spectrometer, and scintillation spectrometer studies of Ba^{133} are presented. A new level in Cs^{133} at 160 keV was found. γ-Rays of energies 56 keV, 79 keV, 160 keV, 224 keV, 227 keV, 302 keV, 358 keV, 383 keV and 437 keV were detected. The conversion coefficients of some of the γ-rays are estimated. It is found by a combination of the summing technique and the conventional coincidence technique that Ba^{133} decays with an energy of (53 ± 2) keV to the 437 keV state of Cs^{133} by K-electron capture (46%) and L-electron capture of (54%). A decay scheme is suggested. A.

539.163.2

3333. THE DECAY OF THE NUCLIDES ^{75}Se AND ^{75}Ge.
H.J.van den Bold, J. van de Geijn and P.M.Endt.
Physica, Vol. 24, No. 1, 23-38 (Jan., 1958).

Gamma transitions in the decay of these nuclides were investigated by scintillation spectroscopy. Single spectra and coincidence spectra were found to conform with the level schemes constructed by previous authors. Directional correlations of five γ-cascades were measured. Polarization correlation measurements were performed on the 121 keV-280 keV and 136 keV-265 keV γ-cascades. The following spins and parities are assigned to levels in As^{75}: ground state $3/2^-$, 199 keV $1/2^-$, 265 keV $3/2^-$, 280 keV $5/2^-$, 304 keV $9/2^+$, 401 keV $5/2^+$. A.

539.163.2

3334. FURTHER STUDY ON THE DECAY OF ^{57}Ni.
J.Konijn, H.L.Hagedoorn and B.van Nooijen.
Physica, Vol. 24, No. 2, 129-36 (Feb., 1958).

For previous work see Abstr. 8797 (1957). In contradiction to the earlier results only three γ-rays were found; the 127 keV γ-ray transition is weaker than reported before and occurs only in (14 ± 1)% of the Ni^{57} disintegrations. The intensities of possible γ-rays of 400 keV and 520 keV are found to be smaller than 0.5% and 1% respectively. The ϵ/β^+ ratios were determined separately; the results are in agreement with theoretical predictions by Zweifel, the Fierz terms therefore are small. The fluorescent yield of Co^{57} was measured as $\omega_K = 0.31 \pm 0.01$. A.

539.164

3335. ABSOLUTE ENERGY MEASUREMENT OF ALPHA PARTICLES FROM Po^{210}. F.A.White, F.M.Rourke, J.C.Sheffield, R.P.Schuman and J.R.Huizenga.
Phys. Rev., Vol. 109, No. 2, 437-42 (Jan. 15, 1958).

The absolute alpha energy of Po^{210} alpha-particles was measured by a 180° magnetic spectrometer. The value obtained was 5.3054 ± 0.0010 MeV (absolute volts). Measurement of the energy (α_0) of the alpha-particles from Cm^{244} leading to the ground state of Pu^{240} was made relative to the energy of the Po^{210} alpha-particles. A value of 5.8025 ± 0.002 MeV was obtained for this Cm^{244} α_0 energy. The energy difference between the ground state transition α_0 and the transition α_1 to the first excited level of Pu^{240} from Cm^{244} was found to be 43.5 ± 1 keV. A.

539.164

3336. ON THE THEORY OF α-DECAY (PARTICULARLY OF THE NUCLEI IN THE REGION OF Pb^{208}). H.J.Mang.
Z. Phys., Vol. 148, No. 5, 582-92 (1957). In German.

A procedure is developed for calculating the constants of α-decay from the wave-functions of the initial and final nuclei and of the α-particle. The equations are evaluated on the basis of shell-model wave-functions, and the two α-decay processes $Po^{211} \rightarrow Pb^{207}$ and $Po^{212} \rightarrow Pb^{208}$ are discussed. A.O.Stanesby

539.164.2

3337. DIRECTIONAL DISTRIBUTION OF ALPHA PARTICLES EMITTED BY ORIENTED NUCLEI.
P.J.Brussaard and H.A.Tolhoek.
Physica, Vol. 24, No. 4, 233-62 (April, 1958).

A theoretical investigation is made concerning the information which may be drawn from experiments on the directional distribution of alpha-particles from oriented nuclei. Formulae are given connecting the directional distribution (for arbitrary nuclei) with the degree of orientation of the alpha-emitting nuclei. The theory of alpha emission of spheroidally deformed nuclei is explained, especially in view of the experiments on this directional distribution. It is discussed by which analysis nuclear information can be obtained from this directional distribution, which cannot be obtained from intensities in alpha fine-structure or alpha–gamma directional correlation. It is shown that simultaneous observation of the directional distribution of the gamma radiation will be of interest. The nuclear information is connected with a preferential emission of the alpha-particle from the poles or from the equator of the surface of the spheroidally deformed nucleus, depending on the internal problem of alpha-particle formation from nucleon states. The relation between directional distributions in the laboratory system and the body fixed system can be visualized for the classical limit by a simple geometrical averaging over the precession of the nucleus. A.

539.164.2

3338. ON THE THEORY OF EMISSION OF ALPHA PARTICLES AS RELATED TO THE STRUCTURE OF THE NUCLEUS.
P.J.Brussaard and H.A.Tolhoek.
Physica, Vol. 24, No. 4, 263-79 (April, 1958).

The internal problem of the formation of the alpha-particles emitted in alpha disintegration is considered. In this respect the mean free path of alpha-particles in nuclear matter is important. A comparison is made with the optical model treatment of alpha-particle scattering; the significance of the alpha-particle potential well parameters is discussed. A short mean free path for the alpha-particles in nuclear matter suggests that the alpha-particle formation can be characterized approximately by a boundary condition on the nuclear surface, which further determines the alpha-particle propagation in the external region. An approximate wave-function representing a nucleus with shell structure emitting an alpha-particle is proposed and provides an expression for this boundary condition. Such an expression can be used for the calculation of absolute as well as relative transition probabilities in alpha-decay. The value for the radius of the alpha-particle potential well, which is obtained in this way from the alpha decay probability is in good agreement with the radius of the potential well determined from alpha-particle scattering. A summary is given of the experimental information which would be useful for a further test of the picture of alpha-particle formation. A.

539.165 : 539.166

3339. COINCIDENCE MEASUREMENTS ON RADIUM C [Bi^{214}].
R.Nierhaus and H.Daniel.
Z. Naturforsch., Vol. 12a, No. 1, 1-10 (Jan., 1957). In German.

β–γ- and e^-–β-coincidence measurements were made on the

RaC → RaC' decay. β-particle groups of energies 1.45 ± 0.05, 1.1 ± 0.1 and about 0.5 MeV were in coincidence with γ-radiation > 0.8 MeV, and a β-particle group of 1.9 ± 0.1 MeV with a lower energy γ-radiation. Any β-particle group of energy about 2.6 MeV has an intensity < 4%. β-particle groups of energies 1.8 ± 0.2 and 1.5 ± 0.2 MeV were in coincidence with conversion electrons from the 1.416 and 0.609 MeV γ-radiations respectively. A decay scheme is suggested. A.O.Stanesby

539.165

3340. ON THE "INTERNAL BREMSSTRAHLUNG" ASSOCIATED WITH THE BETA-DECAY OF Tl^{204}. R.A.Ricci.
Nuovo Cimento, Vol. 8, No. 1, 1-16 (April 1, 1958). In Italian.

The experimental distribution of the internal bremsstrahlung of Tl^{204} β-decay was measured using a γ-scintillation spectrometer. The method used in calibrating the experimental apparatus and in evaluating the "true" experimental spectrum is reported. In the energy interval considered (80-400 keV) the experimental distribution is compared with the theoretical spectra calculated on the basis of the method developed by Knipp and Uhlenbeck and of the Nilsson method, which take into account, in first approximation, the influence of the Coulomb field of the nucleus. The experimental results are in disagreement with the Knipp and Uhlenbeck distribution and agree well with the Nilsson corrected distribution up to a lower limit of about 150 keV, showing, in this case, the importance of the nuclear Coulomb field. Nevertheless, for energies lower than 150 keV, the corrected theoretical spectrum is unsatisfactory; the excess of photons in the lower part of the experimental spectrum is the outstanding feature of the Tl^{204} internal bremsstrahlung. This seems to be in agreement with the results of Starfelt and co-workers, and Langevin-Joliot, for other nuclides. Owing to the fact that the Nilsson theoretical distribution is calculated for allowed transition only, the influence of the β-spectrum shape ("unique first forbidden" in the case of Tl^{204}) cannot be excluded. Between 80 and 400 keV an intensity of $(1.0 \pm 0.1) \times \times 10^{-3}$ photons per disintegration was found; the predicted intensities are 0.637×10^{-3} and 0.789×10^{-3} photons per disintegration, for the Knipp and Uhlenbeck theory and for the Nilsson corrected theory, respectively. A.

539.165 : 539.166

3341. ON THE INTERNAL BREMSSTRAHLUNG IN THE ^{204}Tl BETA DECAY. R.A.Ricci.
Physica, Vol. 24, No. 4, 297-303 (April, 1958).

The experimental distribution of the internal bremsstrahlung accompanying the beta decay in Tl^{204} was measured with the scintillation technique in the energy region between 80 and 400 keV. The results obtained are compared with the theoretical distributions calculated on the basis of the Knipp and Uhlenbeck theory, where the influence of the Coulomb field of the nucleus is neglected, and with the Nilsson theory which takes the Coulomb effect into account. The experimental results agree fairly well with the Nilsson distribution in the region above 150 keV; this agreement no longer holds below this energy and an experimental excess of photons is found, which cannot be explained as due to radiation following the electron capture in Tl^{204}. The Knipp and Uhlenbeck distribution shows disagreement with the experimental one in the whole energy interval investigated. These results seem to point in the same direction as those found recently by other authors for many other nuclides. A.

539.165

3342. COULOMB EFFECTS IN INNER BREMSSTRAHLEN. R.R.Lewis, Jr and G.W.Ford.
Phys. Rev., Vol. 107, No. 3, 756-65 (Aug. 1, 1957).

The Coulomb correction to the photon spectrum accompanying beta decay is calculated, treating the Coulomb field as a perturbation. It is shown that for allowed and unique first-forbidden transitions, the result differs from that of Knipp-Uhlenbeck-Bloch only by the appearance of an extra factor, related to the Sommerfeld factor in ordinary bremsstrahlung. Analytic formulae are presented for these two selection rules, and a comparison made with recent experiments. A.

539.165

3343. DEMONSTRATION OF THE POLARIZATION OF β-PARTICLES FROM $Sr^{90} + Y^{90}$. J.Heintze.
Z. Phys., Vol. 148, No. 5, 560-3 (1957). In German.

The asymmetry of single scattering by a Pt foil through 135°, after multiple scattering of the incident β-particles of $Sr^{90} + Y^{90}$ through about 30°, gave a polarization $|P| \geq (0.82 \pm 0.15)\ v/c$ over the range from 200 to 400 keV (v/c 0.7 – 0.8); the sign is negative. A.O.Stanesby

539.165

3344. NUCLEAR ALIGNMENT AND THE BETA TRANSITION IN COBALT 58. P.Dagley, M.A.Grace, J.S.Hill and C.V.Sowter.
Phil. Mag. (Eighth Ser.), Vol. 3, 489-96 (May, 1958).

A single crystal of nickel fluosilicate has been used for the low-temperature alignment of Co^{58}. Angular distribution measurements of the 805 keV γ-radiation are consistent with the β-transition being pure Gamow–Teller, the Fermi admixture being given by

$$C_F^2 |M_F|^2 / \{C_F^2 |M_F|^2 + C_{GT}^2 |M_{GT}|^2\} = -0.003 \pm 0.005.$$

A.

539.165

3345. ASYMMETRY OF THE POSITON EMISSION FROM POLARIZED ^{58}Co AND ^{52}Mn NUCLEI. H.Postma, W.J.Huiskamp, A.R.Miedema, M.J.Steenland, H.A.Tolhoek and C.J.Gorter.
Physica, Vol. 24, No. 3, 157-68 (March, 1958).

A method for measuring the asymmetry of positron emission by studying its annihilation radiation is described and discussed. If the directional distribution of the positrons from Co^{58} is written as $W(\theta) = 1 + f_1 \beta \cos\theta$ with $f_1 = \langle I_z \rangle / I$, the experimental result can be given as $\beta = (0.24 \pm 0.05)\ (v/c)$. Four different interpretations of this result are discussed. The asymmetry for Mn^{52} is zero within the experimental error. It follows that the nuclear spin of Mn^{52} is 6. A.

539.165 : 539.166

3346. BETA-GAMMA CORRELATIONS FROM ORIENTED NUCLEI. R.B.Curtis and R.R.Lewis.
Phys. Rev., Vol. 107, No. 5, 1381-2 (Sept. 1, 1957).

The measurement of the correlation function for β–γ transitions in oriented nuclei is proposed as a means of determining the validity of time-reversal invariance in the β interaction. Such experiments also provide a sensitive test of the type of Fermi interaction. The correlation function for allowed transitions (Δ J = 0, no) is presented in general form, with a discussion of the conclusions that can be drawn from such experiments. A.

539.165 : 539.166

3347. CORRELATION BETWEEN CIRCULARLY POLARIZED γ-RAYS AND β-PARTICLES.
A.Lundby, A.P.Patro and J.P.Stroot.
Nuovo Cimento, Vol. 6, No. 3, 745-7 (Sept., 1957).

The correlation coefficients for Co^{60} and Na^{22} were found to be −0.32 ± 0.07 and +0.34 ± 0.14 respectively, the γ-ray circular polarization being measured by transmission through magnetized iron. M.A.Grace

539.165 : 539.166

3348. CIRCULAR POLARIZATION OF γ-RAYS EMITTED OPPOSITE TO β-PARTICLES. RESULTS ON ^{46}Sc.
A.Lundby, A.P. Patro and J.P.Stroot.
Nuovo Cimento, Vol. 7, No. 6, 891-4 (March 16, 1958).

Measurements were made with β-rays of v/c about 0.65 using the apparatus previously described (see preceding abstract). The observed asymmetry coefficient of 0.29 ± 0.11 requires interference in the β-transition between Fermi and Gamow–Teller modes. M.A.Grace

539.165.08 : 539.1.07

3349. APPLICATION OF THE KURIE PLOT TO THE STANDARDIZATION OF PURE BETA-EMITTERS. R.S.Lloyd.
Nature (London), Vol. 181, 1055-6 (April 12, 1958).

A method of correcting for low-energy β-particles which escape detection in a 4π proportional counter, by extrapolating the Kurie plot to zero energy, is discussed. M.A.Grace

539.165.2

3350. COULOMB CORRECTIONS IN ALLOWED BETA TRANSITIONS. J.D.Jackson, S.B.Treiman and H.W.Wyld, Jr.
Nuclear Physics, Vol. 4, No. 2, 206-12 (Aug.[2], 1957).

Complete expressions, with all Coulomb effects taken into account, are given for the distribution functions for allowed beta decay, including recoil, nuclear orientation, and electron polarization effects. The expressions are general in that no assumptions are made as to invariance with respect to space inversion, charge conjugation, or time reversal. Simple arguments based on the behaviour of the various momenta and angular momenta under space inversion and time reversal are used to elucidate which combinations of vectors will appear when the different symmetry laws are violated, and the modifications of these arguments necessary because of the Coulomb interaction in the final state are pointed out. Various tests of time reversal invarance, previously suggested, are re-evaluated in view of the results for the Coulomb corrections. A.

539.165.2

3351. FURTHER REMARKS ON COULOMB CORRECTIONS IN ALLOWED BETA TRANSITIONS. M.E.Ebel and G.Feldman.
Nuclear Physics, Vol. 4, No. 2, 213-14 (Aug.[2], 1957).

The terms which were not included in the paper by Jackson, Treiman and Wyld (preceding abstract) are added for completeness. A.

539.166 : 539.17

3352. SOFT γ-RAYS FROM THE CAPTURE OF THERMAL NEUTRONS BY NUCLEI.
I.V Estulin, L.F.Kalinkin and A.S.Melioransky.
Nuclear Phys., Vol. 4, No. 1, 91-111 (Aug.,1957).

A luminescent spectrometer was used to measure the energies and absolute intensities of the γ-quanta emitted by Co^{59}, Rh^{103}, I^{127} Sm^{149}, Au^{197} and Hg^{199} nuclei following the capture of thermal neutrons. It is shown that the γ-lines in the 50-500 keV energy range detected in the present work can be ascribed to transition from the lower excited states of the investigated nuclei. A description of the apparatus and method of measurement is presented. A.

539.166 : 539.17

3353. ANGULAR DISTRIBUTION OF 8.34 MeV γ-RADIATION IN THE $N^{14}(p,\gamma)O^{15}$ REACTION. S.Gorodetzky, A.Gallmann, M.Croissiaux and R.Armbruster.
Nuclear Phys., Vol. 4, No. 1, 112-19 (Aug., 1957). In French.

The resonance at 1060 keV in the reaction $N^{14}(p,\gamma)O^{15}$ was investigated. The angular distribution of the 8.34 MeV radiation has been found to be $W(\theta) = 1 + 0.05\ P_2(\cos\theta)$. It is concluded that the angular momentum of the level at 8.34 MeV in O^{15} is J = 3/2. A.

539.166

3354. GAMMA RADIATION FROM RESONANCE NEUTRON CAPTURE IN MERCURY. H.H.Landon and E.R.Rae.
Phys. Rev., Vol. 107, No. 5, 1333-6 (Sept. 1, 1957).

An experiment was performed to detect individual high-energy gamma-rays associated with resonance capture in mercury, using an electron linear accelerator as a pulsed neutron source. The gamma-ray spectrum from the 34 eV resonance in the compound nucleus Hg^{200} has intense components of higher energy than does the spectrum from thermal capture in this isotope. From this it can be inferred that the spin of the 34 eV resonance is most probably 1 with negative parity. A.

539.166.08

3355. EXPERIMENTAL DETERMINATION OF THE EFFICIENCY OF A GAMMA SCINTILLATION SPECTROMETER. R.A.Ricci.
Physica, Vol. 24, No. 4, 289-96 (April, 1958).

The method consists essentially in measuring the photo-peak areas of the different scattered radiations produced in an Al scatterer by a beam of monochromatic gamma-rays. The number of the primary photons impinging upon the scatterer is known from the intensity of the source and from the geometry. If E_0 is the primary photon energy it is possible to determine: (1) the energy of the scattered collimated beam as a function of E_0 and of the direction θ; (2) the number of photons entering the crystal as a function of the primary intensity, of the angle θ and of the geometry; (3) the crystal efficiency. The experimental apparatus and the results obtained for a 2 × 2 cm NaI(Tl) crystal are reported. The validity of the method is discussed. A.

539.166.08 : 537.312.5

DETERMINATION OF GAMMA-RAY INTENSITIES.
See Abstr. 3139

539.166.83

3356. THE ISOMERIC TRANSITIONS IN Tl^{197} AND Tl^{195}.
G.Andersson, P.A.Tove, B.Jung and I.B.Svensson.
Nuclear Phys., Vol. 3, No. 4, 493-505 (June, 1957).

Internal conversion electrons from the isomeric transitions in Tl^{197} and Tl^{195} were studied in high resolution β-spectrometers. The intensity ratios of the lines, when compared with recent theoretical values, were found to confirm the multipole assignment E3 for both transitions. The γ-energies were established as 222.45 ± 0.05 keV (Tl^{197m}) and 99.1 ± 0.1 keV (Tl^{195m}). The half-lives of Tl^{197m} and Tl^{195m} were measured as 0.55 ± 0.10 sec and 3.5 ± 0.4 sec, respectively, using rapid chemical techniques and a multichannel method of time analysis. Pulse height spectra of the short-lived activities were found to support the mass assignments. A.

539.166.83

3357. NOTE ON THE DECAY OF Tl^{198m}.
G.Andersson and I.Bergström.
Nuclear Phys., Vol. 3, No. 4, 506-12 (June, 1957).

The energies and intensities of the conversion electrons of the 48 keV γ-ray emitted in the decay of 1.75 h Tl^{198m} were measured in a high resolution spectrometer. The 48 keV γ-ray is converted in Hg, which leads to a revised level scheme of Tl^{198}, the levels being 7+ (543.1 keV) 3− (282.4 keV) and 2- (0 keV). The relative conversion intensities in the L and M subshells, respectively, agree perfectly with those obtained from the E2 conversion coefficients by Rose et al. A.

539.166.83

3358. IDENTIFICATION OF THE INTERNAL CONVERSION SPECTRA OF THE LONG-LIVED ISOTOPES Eu^{152} AND Eu^{154}.
B.V.Bobykin and K.M.Novik.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 2, 263-6 (1957). In Russian.

A detailed study using a double-focusing beta-spectrometer. Results given in figures and in an extensive table. W.O.Lock

539.166.83

3359. INVESTIGATION OF CONVERSION LINES IN THE β-SPECTRUM OF Ir^{192}.
V.M.Kelman, R.Ya.Metskhvarishvili, V.A.Romanov and V.V.Tuchkevich.
Nuclear Physics, Vol. 4, No. 2, 240-7 (Aug.[2], 1957).

A prism β-spectrometer with a resolving power of 0.04% was employed to study the conversion electron spectrum of excited Pt^{192} and Os^{192} produced in the disintegration of Ir^{192}. The conversion coefficient ratios K/L and $L_I : L_{II} : L_{III}$ were determined for transition energies 136.3, 201.3, 205.8, 295.9, 308.5, 316.5, 468.0 and 604.5 keV; for the most intense transitions the ratios K/M, $M_I : M_{II} : M_{III}$, K/N and K/O were also determined. All investigated transitions were found to be of the E2 or E2 + M1 type. The contribution of the M1 admixture was determined. A.

539.166.83

3360. AN INTERNAL CONVERSION COEFFICIENT FOR THE OUTERMOST ELECTRON SHELL IN XENON.
A.E.S.Green and A.H.Snell.
Proc. Roy. Soc. A, Vol. 242, 400-2 (Nov. 5, 1957).

The observed intensity of the singly charged ions in the charge spectrum produced by the isomeric decay of 12-day Xe^{131} is used in conjunction with a theoretical estimate of the radiation probability of the (5p—1s) X-ray transition in the K-series of xenon, to yield a value for the internal conversion coefficient of the 163 keV γ-ray in the 5p-shell. The value so obtained is 0.21 ± 0.03. A.

539.166.83

3361. THE ELECTRIC MULTIPOLE INTERNAL CONVERSION INDUCED BY NEUTRON TRANSITION. Tzu Hung-Yüan.
Scientia Sinica, Vol. 7, No. 2, 179-200 (Feb., 1958).

The effect of the anomalous magnetic moment of the nucleon on the value of the internal conversion coefficient is investigated. The parts played by the scalar and the longitudinal photons in the process of internal conversion are first discussed. The retarded interaction between the charged particles with anomalous magnetic moment is derived by the correspondence method. The result obtained is then verified by the quantum electrodynamical treatment. The retarded interaction thus obtained is applied to the calculation of the internal conversion coefficient. It is found that the anomalous magnetic moment of the nucleon has negligible influence upon the coefficient of the magnetic conversion and the coefficient of the electric conversion induced by the proton transition. However, the anomalous magnetic moment of the nucleon does cause considerable modification of the coefficient of the electric conversion induced by the neutron transition, contrary to the conclusion arrived at by other authors. The problem of the gauge transformation is discussed and the errors in the treatment given by other authors are pointed out. A.

NUCLEAR REACTIONS

539.17 : 530.145

3362. TIME REVERSAL AND POLARIZATION PHENOMENA IN N + N ⇌ d + π REACTIONS. L.I.Lapidus.
Nuclear Phys., Vol. 4, No. 1, 145-56 (Aug., 1957).

An analysis of polarization phenomena in N + N ⇌ d + π reactions (where N is a nucleon) reveals how time-reversal invariance leads

to connections between polarization phenomena in direct and inverse reactions. The Wolfenstein theorem has been extended to the case of a binary reaction. Expressions are given for various observable quantities in $N + N \rightleftharpoons d + \pi$ reactions for the case when only s, p and d-waves with $J \leq 2$ are considered as well as for the general case. A.

539.17

3363. NUCLEAR DISINTEGRATION ENERGIES. II.
D.M.Van Patter and W.Whaling.
Rev. mod. Phys., Vol. 29, No. 4, 757-66 (Oct., 1957).

Q-values are given for nuclear reactions, the previous compilation (Abstr. 2099/1955) being revised and augmented.

L.L.Green

539.17

3364. ANGULAR OPERATORS FOR NUCLEAR REACTIONS.
V.I.Ritus.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1536-46 (1957). In Russian.

A deduction is given of an orthogonal and normalized system of invariant angular operators, that is of matrices into which the scattering amplitude can be expanded. The angular operators correspond to transitions with definite quantum numbers in the initial and final states and completely define the angular distribution and polarization of the particles in these transitions. The explicit form of the operators is presented for scattering and photoproduction of mesons on nucleons and for scattering of photons and nucleons on nucleons. A.

539.17

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.17

3365. DIRECT INTERACTION THEORY OF INELASTIC SCATTERING. III. NUMERICAL CALCULATIONS.
C.A.Levinson and M.K.Banerjee.
Ann. Phys. (New York), Vol. 3, No. 1, 67-90 (Jan., 1958).

For Pt II see Abstr. 1946 (1958). A report is given of calculations of the process $C^{12}(p,p')C^{12*}Q = 4.4$ MeV and the (p', γ) angular correlation following. The direct interaction theory, using distorted waves discussed previously, is used and found to give a quantitative fit to the inelastic differential cross-section in the energy range $E_p = 14$ to 185 MeV and to the angular correlation at 16 and 19 MeV. A.

539.17

3366. CROSS-SECTION FOR INELASTIC INTERACTION BETWEEN PROTONS WITH KINETIC ENERGY ABOVE 7 BeV AND THE NUCLEI OF CARBON ATOMS.
K.I.Alekseeva and N.L.Grigorov.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 2, 259-62 (1957). In Russian.

Cosmic-ray protons are collimated and energy-selected by a counter telescope and their interactions with carbon nuclei give rise to events which are detected and recorded by conventional coincidence circuitry. From a statistical analysis of these events it is deduced that the inelastic cross-section for high-energy (> 7 BeV) protons on carbon nuclei is 264 ± 24 millibarns. J.W.Gardner

539.17 : 537.591.8

3367. INTERACTION OF COSMIC-RAY PROTONS OF ENERGIES OF ABOUT 10^{10} eV WITH LEAD NUCLEI.
L.T.Baradzeĭ, V.I.Rubtsov, Yu.A.Smorodin, M.M.Solov'ev, B.V.Tolkachev and Z.I.Tulinova.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 4, 685-8 (1957). In Russian.

A study of the energy balance in 38 showers produced in a lead plate in a Wilson cloud chamber, at 9000 m altitude. The results agree with emulsion data in the same energy range. W.O.Lock

539.17

3368. RADIOCHEMICAL INVESTIGATION OF THE REACTION $Si^{30}(p,\pi^+)Si^{31}$. S.Sekerskiĭ and A.K.Lavrukhina.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 1, 61-4 (1957). In Russian.

Dependence of the cross-section on energy is measured for incident protons of energy 120 to 660 MeV. G.E.Brown

539.17

3369. THE SCATTERING OF 181 MeV PROTONS OFF HELIUM.
H.Tyrén, G.Tibell and T.A.J.Maris.
Nuclear Physics, Vol. 4, No. 2, 277-81 (Aug.[2], 1957).

The energy spectra of 181 MeV protons scattered off helium were recorded with a magnetic analyser. Gaseous helium was used as a target, and four angles were studied: $10^0.2$, $14^0.2$, $18^0.2$, and $23^0.2$. A.

539.17

3370. NEUTRON ALPHA PARTICLE ANGULAR CORRELATION IN THE REACTION $^7Li(d,\alpha)$ AND THE GROUND STATE OF ^5He.
F.J.M.Farley and R.E.White.
Nuclear Phys., Vol. 3, No. 4, 561-70 (June, 1957).

At a bombarding energy of 160 keV, the reaction $Li^7(d,\alpha)He^5$ was isolated by selecting the corresponding group of monoergic alpha-particles with a differential detector and the angular distribution of the coincident neutrons from the disintegration of He^5 was then studied with a scintillation counter. The neutrons are emitted within a cone, and from the distribution through the cone it is deduced that the angular distribution function for the disintegration of He^5 with respect to the direction of emission of the initial alpha-particle is $f(\theta) = 1 + A \sin^2\theta$. The results can be fitted for $A = 0.72$ with the distribution of He^5 excitation energies used by Adair in interpreting data on neutron scattering by helium. The dynamics of the experiment are such that the ground state properties predominate in the results for the angular distribution thus confirming that the ground state has spin 3/2, since a spin of $\frac{1}{2}$ would lead to isotropy. A.

539.17

3371. DEUTERON STRIPPING ON SPHEROIDAL NUCLEI.
J.Sawicki.
Nuclear Phys., Vol. 6, No. 4, 575-84 (April [2], 1958).

An explanation is proposed of the effect of mixtures of two or more l-values in (d,p) stripping angular distributions from the point of view of the spheroidal nuclear model. S.G.Nilsson's wavefunctions are employed to represent the captured neutron. General properties of the cross-sections and selection rules are discussed. Qualitative agreement is obtained in a number of examples. Angular γ--p correlations of γ-rays following (d,p) stripping reactions are discussed. Polarization of the outgoing protons is calculated. A.

539.17

3372. INELASTIC SCATTERING OF DEUTERONS FROM SPHEROIDAL NUCLEI. J.Sawicki.
Nuclear Phys., Vol. 6, No. 4, 613-17 (April [2], 1958).

A direct interaction theory of (d,d') reactions is proposed for strongly deformed nuclei of mass number $A \approx 24$. Strong-coupling approximation of the unified nuclear model is employed to represent the nucleus and the differential cross-section is calculated in Born approximation for rotational excitations up to the fourth power of the deformation parameter β. The theory is applied to the $Mg^{24}(d,d')Mg^{24}$ (1.37 MeV) reaction. Agreement with experiment is obtained both for the angular distribution (except for $\theta < \sim 20^0$) and for the total cross-section. Further extensions of the model are indicated. A.

539.17

3373. ANGULAR DISTRIBUTIONS OF TWO PROTON GROUPS FROM THE REACTION $Na^{23}(d,p)Na^{24}$. C.E.Dickerman.
Phys. Rev., Vol. 109, No. 2, 443-6 (Jan. 15, 1958).

The resolved angular distributions of $Na^{23}(d,p)Na^{24}$ protons leaving Na^{24} in the 0.472 and 0.564 MeV levels were obtained with a double-focusing magnetic spectrometer, using a bombarding energy of 2.95 MeV (lab). The angular distribution corresponding to the transition to the 0.472 MeV level shows evidence of a large contribution from compound-nucleus formation. A Butler-type analysis of the angular distribution of protons leading to the 0.564 MeV level indicates that this level must have spin 1+ or 2+. A.

539.17

3374. A BEAM-SCANNED ROTATING HEAVY-ICE TARGET FOR HIGH LOADS. J.H.Spaa.
J. sci. Instrum., Vol. 35, No. 5, 175-8 (May, 1958).

From the several possible targets for the D(d,n) He^3 reaction the heavy-ice target proves to be the most suitable for outputs of about 10^{10} neutrons/sec. Beam scanning in two perpendicular directions, combined with rotation of the target is found to be necessary to secure a sufficient life of the ice surface. A.

539.17

3375. ON THE NEUTRONS FROM THE N^{14} (d,n) O^{15} REACTION. II.
I.Nonaka, S.Morita, N.Kawai, T.Ishimatsu, K.Takeshita, Y.Nakajima and N.Takano.
J. Phys. Soc. Japan, Vol. 12, No. 8, 841-5 (Aug., 1957).

For Pt I see Abstr. 1576 (1956). The angular distribution of the neutrons from the $N^{14}(d,n)O^{15}$ reaction leading to the O^{15} ground state was investigated in the angular range from 0^0 to 165^0 (lab. system) by the photographic method. The energy of the bombarding deuterons was 1.96 MeV, and the Q-value was found to be $Q_0 = (5.13 \pm 0.05)$ MeV. The angular distribution shows a maximum

at about 30° (c.m.s.) and decreases considerably beyond this maximum, in accordance with what is characteristic to the stripping process corresponding to $l_p = 1$. In the backward direction, the intensity of neutrons increases remarkably and reaches a value almost three times as large as that of the forward maximum. The absolute cross-section of this reaction was estimated to be $\sigma(0^\circ) = (2.4 \pm 0.7)$ millibarn/sterad, and $\sigma = (38 \pm 7)$ millibarn. A.

539.17 : 537.591.8

3376. INTERACTION OF HIGH-ENERGY PARTICLES WITH NUCLEI. A.P.Zhdanov, I.B.Berkovich, K.I.Ermakova, F.G.Lepekhin, N.V.Skirda and Z.S.Khokhlova.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 6, 1093-6 (1957). In Russian.

A large number of nuclear events produced by cosmic-ray nucleons with energies of 10^{11}-10^{13} eV were observed in an emulsion which had been exposed for 7 hours at a height of about 30 km. The events were analysed according to the kinds, numbers, energies and angular distributions of the ejected particles, and the results are compared with current phenomenological theory. J.W.Gardner

539.17

3377. INDIVIDUAL PARTICLE AND COLLECTIVE ASPECTS OF THE NUCLEAR PHOTOEFFECT. D.M.Brink.
Nuclear Physics, Vol. 4, No. 2, 215-20 (Aug.[2], 1957).

The coordinate corresponding to the diple photon absorption operator is exactly separable in the oscillator shell model. It is shown that in an electric dipole absorption a mode of the shell model is excited in which the protons vibrate against the neutrons. In shell models other than the oscillator model this collective mode is damped; in heavy nuclei this damping gives a line width of ≈ 4 MeV. A.

539.17

3378. AN ALPHA-PARTICLE MODEL FOR THE NUCLEAR PHOTODISINTEGRATION OF O^{16}. H.Wilhelmsson and M.Nilsson.
Nuclear Physics, Vol. 4, No. 2, 234-9 (Aug.[2], 1957).

The photonuclear effect in O^{16} is studied theoretically for the case of one emitted nucleon. The giant resonance is described with the aid of a simple model, which assumes that in the O^{16} nucleus only four nucleons, forming an α-particle, are affected by the γ-ray. The α-particle is assumed to be moving in a static collective potential from the other nucleons, these being undisturbed during the photodisintegration process. Gaussian wave-functions are used. The results obtained are not in disagreement with recent experimental information. A.

539.17

3379. NOTE ON THE (γ,d) REACTIONS. J.Sawicki and W.Czyż.
Nuclear Physics, Vol. 4, No. 2, 248-56 (Aug.[2], 1957).

The large observed ratios of (γ,d) to (γ,p) cross-sections are explained in terms of a two-stage mechanism of the (γ,d) process from the point of view of the nuclear shell model. The incident photon is assumed to be absorbed by a single nucleon which in its turn picks up another nucleon within the nucleus with the right momentum to form an outgoing deuteron. The method of calculation of $\sigma(\gamma,d)/\sigma(\gamma,p)$ in a general case is presented. The example of the $S^{32}(\gamma,d)\,P^{30}$ reaction is discussed. The importance of investigating (γ,d) angular distributions is indicated. A.

539.17

3380. PHOTODISINTEGRATION OF HELIUM.
A.N.Gorbunov and V.M.Spiridonov.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 21-32 (1957). In Russian.

Photodisintegration of helium was studied in a cloud chamber located in a magnetic field and synchronized with a 170 MeV bremsstrahlung beam. The yields of various photonuclear reactions in helium, the energy dependence of the effective cross-section for the $He^4(\gamma,p)\,H^3$ reaction and also the angular distributions of protons and tritons arising in this reaction were measured. The results are compared with the data obtained in other investigations and with theoretical predictions. A.

539.17

3381. ENERGY AND ANGULAR DISTRIBUTIONS OF NEUTRONS FROM THE INTERACTION OF 14.1 MeV NEUTRONS WITH ZIRCONIUM. Se Hee Ahn and J.H.Roberts.
Phys. Rev., Vol. 108, No. 1, 110-13 (Oct. 1, 1957).

These were obtained by using nuclear emulsion plates as detectors. The energy distribution of the low-energy nonelastic neutrons is Maxwellian. The angular distribution of the low-energy nonelastic neutrons (0.5-4.0 MeV) is found to be isotropic; whereas, that of the high-energy nonelastic neutrons (4.0-12.0 MeV) is peaked in the forward direction. The significance of these results in terms of the statistical model of the nucleus is discussed. A.

539.17

3382. THE ELASTIC SCATTERING OF 350 MeV NEUTRONS BY COMPLEX NUCLEI. A.Ashmore, D.S.Mather and S.K.Sen.
Proc. Phys. Soc., Vol. 71, Pt 4, 552-64 (April, 1958).

Differential cross-sections have been measured for the elastic scattering of neutrons with a mean energy of 351.5 ± 3 MeV by lead, tin, copper, aluminium and carbon. Measurements were made out to the first diffraction minimum. The total elastic scattering cross-sections subtracted from the total cross-sections measured previously, give upper limit values for the absorption cross-sections. By comparison with other measurements the absorption cross-sections are seen to be essentially constant from 140 MeV to 1.4 GeV. Values of the radius of the black disk, giving an angular distribution which, when normalized, fits the experimental points, are found to be in agreement with those deduced from measurements of high-energy electron scattering. From the values of the forward scattering cross-sections and the previously measured values of the total cross-sections, it is found that within the accuracy of the measurement the forward scattering amplitude is purely imaginary. A.

539.17

3383. THE ACTIVATION CROSS-SECTION OF THE THULIUM ISOTOPE Tm^{170} AND A DETERMINATION OF THE INTENSITIES OF [ITS] USEFUL RADIATIONS. H.Houtermans.
Z. Phys., Vol. 149, No. 2, 215-24 (1957). In German.

The radiations from Tm^{170} were examined using a 4π-counter and a scintillation spectrograph. The activation cross-section of the reaction $Tm^{169}(n,\gamma)Tm^{170}$ for reactor neutrons is 110 ± 10 barn; the relative intensities of the 84 keV γ-radiation and the 52 keV Yb X-radiation are respectively (3.37 ± 0.15) and (4.2 ± 0.2)%; the conversion coefficient α_K of the 84 keV transition is 1.34 ± 0.08. A.O.Stanesby

539.17 : 539.14

NEUTRON REACTIONS IN SEVERAL NUCLEI. See Abstr. 3323

539.17 : 539.166

CAPTURE OF THERMAL NEUTRONS BY NUCLEI. See Abstr. 3352

539.17

3384. CAPTURE OF A K^--MESON WITH EMISSION OF $_\Lambda He^5_2$. B.P.Bannik, D.K.Kopylova and A.A.Nomofilov.
Dokl. Akad. Nauk SSSR, Vol. 116, No. 6, 939-42 (1957). In Russian.

The analysis shows that the decay scheme is

$$_\Lambda He^5 \rightarrow He^4 + p + \pi^-.$$

The possibility that the formation of this hyperfragment takes place initially through a Σ^--particle is discussed. G.E.Brown

539.17 : 539.163.1

3385. ON SOME STRONTIUM AND YTTRIUM ISOTOPES FROM URANIUM FISSION. G.Herrmann and F.Strassmann.
Z. Naturforsch., Vol. 11a, No. 11, 946-54 (Nov., 1956). In German.

Continuation of Abstr. 6476 (1955). No trace was found of the series 6-10 day Sr → > 100 day Y, the yield of such a supposed fission chain being less than 3×10^{-5}%. Half-lives, radiation energies and fission yields were measured for several isotopes of Sr and Y. A.O.Stanesby

539.17 : 537.534

NUCLEAR CHARGE DISTRIBUTION OF FISSION FRAGMENTS. See Abstr. 3189

539.17

3386. RECOIL STUDIES OF HIGH-ENERGY FISSION OF BISMUTH AND TANTALUM. N.T.Porile and N.Sugarman.
Phys. Rev., Vol. 107, No. 5, 1410-21 (Sept. 1, 1957).

The recoil properties of a number of fission fragments formed in 450 MeV proton bombardment of bismuth and tantalum were investigated radiochemically. The ranges of the fragments emitted in the direction of, and perpendicular to the beam were measured. The kinetic energies of the fragments were obtained from the measured ranges using a previously determined range—energy relation. The total average kinetic energy released in fission was found to be 111 MeV for bismuth and 96 MeV for tantalum. The energy deposited in the target nuclei for processes leading to the observed fragments was obtained from the forward—backward asymmetry and the other measured recoil parameters, and a momentum-deposition energy relation from recent Monte Carlo calculations. The average deposition energy in the fission of bismuth and tantalum was found to be 160 MeV and 190 MeV, respectively. A.

539.17

3387. ANGULAR DISTRIBUTION OF PHOTOFISSION FRAGMENTS FROM URANIUM. B.P.Bannik, N.M.Kulikova, L.E.Lazareva and V.A.Yakovlev.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 53-5 (1957). In Russian.

The angular distribution of fission fragments from uranium irradiated with X-rays of maximum energy E_{max} = 0.4, 12 and 26.5 MeV from a 30 MeV synchrotron measured. The anisotropy sharply increases with decrease in the X-ray energy. The ratios of the anisotropic and isotropic fission yields are equal to 0.55 ± 0.09, 0.13 ± 0.05 and 0.05 ± 0.04 respectively. A.

539.17 : 539.163.1

3388. SPONTANEOUS FISSION OF Th^{232} AND NUCLEON STABILITY.
F.N.Flerov, D.S.Klochkov, V.S.Skobkin and V.V.Terent'ev.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 1, 69-71 (1958). In Russian.

In a precision experiment, not a single act of spontaneous fission is registered, giving a lower limit on the decay half-life of 10^{21} years. From this, one can say that the lifetime of a bound nucleon relative to decay into light particles is greater than 2×10^{23} years.

G.E.Brown

539.17

3389. A REMARK ON THE FREQUENCY OF NUCLEAR PROCESSES CATALYZED BY μ-MESONS IN LIQUID HYDROGEN.
H.Marschall and T.Schmidt.
Z. Phys., Vol. 148, No. 2, 233-5 (1957). In German.

Alvarez and others (Abstr. 5651/1957) showed that μ-mesons can form mesonic molecules. Such a molecule is similar to a H_2^+ molecule, but 210 times smaller, so that the reaction $p + d \rightarrow He^3 + \gamma + 5.4$ MeV is catalyzed. Such processes were observed in a hydrogen bubble chamber, but it was difficult to explain why such molecules are formed much more often than the natural abundance of deuterium would lead one to expect. The binding energies of mesonic molecules were calculated by the authors by means of an approximation of the H^+ potential, suitably scaled for μ-mesons, by a Morse potential function. They are about 200 eV and not very different for $(pp)\mu$ and $(pd)\mu$ molecules. But the first excited vibration state is virtual for $(pp)\mu$ and real for $(pd)\mu$. Moreover the binding energy of this state is only a few volts. It is suggested that the formation of $(pd)\mu$ molecules is favoured by this circumstance. H.Motz

539.17

3390. LONG-WAVE NEUTRON SPECTRUM OF THE MATERIALS TESTING REACTOR. L.B.Borst and L.G.Miller.
J. appl. Phys., Vol. 28, No. 5, 547 (May, 1957).

The long-wave spectrum of a neutron beam from the Be reflector of the Materials Testing Reactor (MTR), Idaho, U.S.A., was measured from 3 to 10 A by a total reflection technique. The spectrum was found to vary as $\lambda^{-3.9}$. A.

539.17 : 537.525

3391. CONTROLLED THERMONUCLEAR REACTIONS.
A.Gibson.
Nature (London), Vol. 181, 803-6 (March 22, 1958).

A report of a Royal Society discussion on February 5, 1958, in London, at which papers on controlled thermonuclear reactions were given. P.C.Thonemann, R.S.Pease and W.B.Thompson read papers on Zeta; A.A.Ware on Sceptre III; G.P.Thompson and J.D.Jukes on some general properties of toroidal discharges; R.J.Tayler on the stability of discharges with axial magnetic fields; D.Gabor on heating and collective oscillations in Zeta; K.W.Allen on experiments with straight discharge tubes at A.W.R.E., Aldermaston. See also Abstr. 773-9 (1958). R.S.Pease

ATOMS

539.18

3392. ADIABATIC APPROXIMATION IN THE QUANTUM THEORY OF ATOMS. M.G.Veselov and I.G.Bersuker.
Vestnik Leningrad. Univ. Ser. Fiz. Khim. No. 3 (1957) No. 16, 55-6. In Russian.

The separation of the motion of the series electrons from that of the core is considered in adiabatic approximation. The motion of core electrons is considered for various configurations of the outer electrons while the series electrons are treated as moving under the averaged field of the core electrons. This takes account of the polarization of the inner atomic shells by the series electrons. The case of the Si atom is taken as an example. C.R.S.Manders

539.18

3393. OPEN SHELL CALCULATIONS FOR THE TWO- AND THREE-ELECTRON IONS.
R.P.Hurst, J.D.Gray, G.H.Brigman and F.A.Matsen.
Molecular Phys., Vol. 1, No. 2, 189-95 (April, 1958).

Open shell calculations are made for all the three-electron atomic systems of the second period of the periodic table. These results are compared with corresponding two-electron and experimental energies. It is noted that the improvement of open shell over closed shell calculations becomes less with increasing atomic number. In parallel trend the disparity of both from the experimental results increases with Z. An electron affinity of zero is found for the helium atom. A.

539.18

3394. STATISTICAL THEORY OF MANY-ELECTRON SYSTEMS. DISCRETE BASES OF REPRESENTATION. S.Golden.
Phys. Rev., Vol. 107, No. 5, 1283-90 (Sept. 1, 1957).

The density matrix for a many-electron system is examined. A formalism is arrived at which facilitates its evaluation in terms of a basis corresponding to a discrete spectrum of eigenvalues. This allows a representation to be employed associated with a suitably chosen approximation to the Hamiltonian. Thereby, reasonably accurate estimates of the properties of many-electron systems may be anticipated for low orders of approximation. In developing the formalism, attention was focussed upon a means for approximating the quantity exp(zH), where H is the many-particle Hamiltonian and z is a complex number. It is found possible to represent this quantity exactly as an infinite product of exponential factors, each of which depends upon a portion of the Hamiltonian alone. The relation of this result to statistical mechanical applications is indicated. An approximation procedure is described in terms of which various finite products of exponential factors approach the desired quantity in the limit of indefinitely increasing numbers of factors; this limit is approached in a manner that permits any given approximation to contain all the terms of the previous approximation. The first order of approximation is employed to approximate the many-particle density matrix. The resulting theory is applied to the helium-like systems: He, Li^+, Be^{++}. The energies of the ground ^1S state of helium and the three lowest states of Li^+ and Be^{++} are calculated. The agreement with experimental term values is reasonably satisfactory, the discrepancy between calculations and experiments not exceeding 1%. The triplet—singlet splitting for Li^+ is in the order observed; the magnitude calculated was about one-half that observed. The relation between the present theory and the Thomas—Fermi theory is discussed. It is pointed out that the former is the analogue of the latter when the density matrix is expressed in other than eigenfunctions of momentum. The quasi-classical character of the approximation is discussed. A.

539.18

3395. SELF-CONSISTENT FIELD WITHOUT EXCHANGE FOR U^{6+}. E.C.Ridley.
Proc. Roy. Soc. A , Vol. 243, 422-34 (Jan. 14, 1958).

The results of a self-consistent field calculation without exchange for U^{6+} are presented. Initial estimates of the field were obtained by a process of extrapolation based on a comparison of isoelectronic series having the configuration $(ns)^2(np)^6$ in the outer shell. A.

539.18

3396. VARIATION OF ATOMIC WAVE FUNCTIONS WITH ATOMIC NUMBER. D.R.Hartree.
Rev. mod. Phys., Vol. 30, No. 1, 63-8 (Jan., 1958).

Defining the screening parameter σ by $R = R_H/N-\sigma$ where R is a scale length characterizing the linear dimensions of an atomic wave-function, R_H its value for hydrogen, N the atomic number, it is noted that σ can vary considerably with the property chosen to define R. Here R is chosen to be equal to the mean radius $\bar{r}$. The asymptotic behaviour of the wave-functions and σ for large N are found. Graphs plotting σ for the 2p, 2s, 3d wave-functions (calculated from the Fock equations) and also plotting the reduced 2p and 2s wave-functions, all against $\bar{r}$ are very nearly linear and thus useful for interpolation purposes. M.J.Kearsley

539.18 : 539.219

3397. ON THE STATES OF ATOMS IN ALLOYS OF THE TRANSITION ELEMENTS. I.Ya.Dekhtyar.
Fiz. Metallov i Metallovedenie, Vol. 5, No. 1, 17-22 (1957).
In Russian.

The influence of the electron configuration in free transition-metal atoms on the degree of filling of the d-bands in their solid

alloys is discussed. Experimental evidence from spectroscopy, neutron diffraction, magnetic measurements and K-absorption edge determinations is analysed and found to give information about s–d electron interaction. A.F.Brown

539.18 : 535.343

3398. PARAMAGNETIC AND OPTICAL SPECTRA OF DIVALENT NICKEL IN CUBIC CRYSTALLINE FIELDS. W.Low.
Phys. Rev., Vol. 109, No. 2, 247-55 (Jan. 15, 1958).

The paramagnetic resonance spectrum of divalent nickel in cubic MgO was investigated. The spectrum is isotropic with one line at $g = 2.227 \pm 0.002$. Eight optical absorption lines at 8600, 13 400, 14 800, 21 550, 24 500, 25 950, 28 300, and 34 500 cm^{-1} were detected. These absorption lines are interpreted as transitions between the singlet ground state and all possible Stark levels of the F, P, D, and G levels. Agreement is obtained to within 300 cm^{-1} by using crystalline field theory, with parameters $Dq = 860\ cm^{-1}$, $Ep = 13\,000\ cm^{-1}$, $E_D = 10\,900\ cm^{-1}$, $E_G = 19\,600\ cm^{-1}$, and λ (the spin–orbit coupling constant) $= -245\ cm^{-1}$. The significance of the reduced values of the energy levels and the spin–orbit coupling constant is discussed. A.

539.18 : 535.343

3399. PARAMAGNETIC AND OPTICAL SPECTRA OF DIVALENT COBALT IN CUBIC CRYSTALLINE FIELDS. W.Low.
Phys. Rev., Vol. 109, No. 2, 256-65 (Jan. 15, 1958).

The optical and paramagnetic resonance spectra of divalent cobalt in MgO single crystals are reported. The optical spectrum consists of stronger lines which correspond to transitions between Stark levels of the same multiplicities and weak intercombination lines. If the Slater integrals are taken as free parameters then in the intermediate coupling scheme good agreement is obtained between the observed and calculated spectrum with $Dq = 960\ cm^{-1}$. The Slater integrals are reduced by about 8-10% from those of the free ion. The paramagnetic resonance spectrum shows one electronic isotropic transition consisting of eight hyperfine lines at $g = 4.278_s \pm 0.001$ and $A = (97.7_9 \pm 0.2) \times 10^{-4}\ cm^{-1}$. The interpretation of these results shows that the orbital reduction factor $k = 0.89 - 0.85$. Both the optical and paramagnetic results indicate covalent bonding. The effect of charge transfer is (1) to shield the nuclear charge and (2) to normalize the wave-functions. Both these effects result in smaller Coulomb energy, hyperfine structure, and spin–orbit coupling constant. No distortions of octahedral symmetry were found to within $10^{-3}\ cm^{-1}$. The static Jahn–Teller effect which predicts such a distortion is, therefore, very small. A.

539.18

3400. PARAMAGNETIC RESONANCE SPECTRUM OF TRIVALENT GADOLINIUM IN THE CUBIC FIELD OF CALCIUM FLUORIDE. W.Low.
Phys. Rev., Vol. 109, No. 2, 265-71 (Jan. 15, 1958).

The paramagnetic resonance spectrum of Gd^{3+} in CaF_2 is analysed at 3 cm wavelength at room and liquid helium temperatures. The spectrum shows that the cubic symmetry is essentially preserved around the gadolinium ion. The fourth-order and sixth-order cubic field splitting parameter are evaluated as $c = +0.0185 \pm 0.0005$ and $d = -0.0004 \pm 0.0002\ cm^{-1}$, where the total ground-state splitting is $8c - 2d$. The g factor is $g = 1.991 \pm 0.002$. Various mechanisms causing the ground-state splitting of an S state in a cubic field are discussed. The preservation of cubic symmetry and the absence of association with vacancies or interstitial ions can be explained by a stabilization of the complex by the spherical charge distribution of the S ion and an effective strong crystalline field. A.

539.18

3401. VACUUM POLARIZATION IN MESOATOMS.
G.E.Pustovalov.
Zh. éksper. teor. Fiz., Vol. 32, No. 6, 1519-27 (1957). In Russian.

Level shifts in mesoatoms due to vacuum polarization produced by the nuclear electric field are computed. Closed formulae are obtained for the first six level shifts by means of recursion relations between the meson wave-functions. For heavy mesoatoms the shifts for the first three levels are computed with account of the finite volume of the nucleus. A.

539.18

3402. SEPARATION OF ISOTOPES BY THE PASSAGE OF AN ATOMIC BEAM THROUGH AN IONIZING REGION.
K.D.Sinel'nikov, B.G.Safronov, G.G.Aseev and Yu.S.Azovskii.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 1, 80-3 (1957). In Russian.

The theory of the method is given. Experiments with a mixture of Hg^{198} and Hg^{204} gave enrichments in reasonable accord with the theory. W.O.Lock

539.18

3403. ON ISOTOPIC EXCHANGE BETWEEN GASEOUS HYDROGEN AND SOLID POLYMERS UNDER THE ACTION OF IONIZING RADIATIONS. Ya.M.Varshavskii, G.Ya.Vasil'ev, V.L.Karpov, Yu.S.Lazurkin and I.Ya.Petrov.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 2, 315-16 (1958). In Russian.

A study of the isotopic exchange between gaseous deuterium and solid polymers exposed to radiation from a reactor. The deuterium concentration was found to be of the order of 0.06 to 0.18%, depending on the polymer used; possible mechanisms for the take-up process are discussed. W.O.Lock

539.18 : 532.14

MEASUREMENT OF LOW DEUTERIUM CONCENTRATION IN WATER BY MEANS OF FLOAT METHOD. See Abstr. 2834

539.18

3404. INTERACTION ENERGIES AND SCATTERING CROSS SECTIONS OF HYDROGEN IONS IN HELIUM.
E.A.Mason and J.T.Vanderslice.
J. chem. Phys., Vol. 27, No. 4, 917-27 (Oct., 1957).

The interaction energies for the H^+–He and H_2^+–He system are calculated for a range of internuclear distances and, in the H_2^+–He case, for two different configurations. The results are used to analyse the ion-scattering measurements of Simons and co-workers. It is found that the predicted scattering cross-sections are in remarkable agreement with the measured ones, provided allowance is made for a finite width of the ion beam, as suggested by Amdur and Harkness. This agreement implies that the method of interpreting measured cross-sections in terms of molecular forces is correct, and that specific apparatus effects have been correctly analysed. The present calculations suggest, in contrast to previous assumptions, that the important forces are ones of repulsion rather than attraction, with the exception of those cases where chemical binding is clearly involved. As expected, to obtain precise force information of physical significance from such scattering measurements, it is again necessary to make allowance for the finite width of the ion beam. This is illustrated for the scattering of H_3^+ ions in helium. Finally, the cross-section equations are integrated for the case of scattering by an exponential potential and by a Lennard-Jones (8-4) potential. A.

539.18

3405. ON THE PHYSICAL INTERPRETATION OF THE RELATIVISTIC CORRECTIONS TO THE VAN DER WAALS FORCE FOUND BY PENFIELD AND ZATSKIS. E.A.Power and S.Zienau.
J. Franklin Inst., Vol. 264, No. 5, 403-7 (Nov., 1957).

A detailed discussion of the relativistic corrections to the Van der Waals force is given for a simple model in which the neutral atoms are replaced by two linear oscillators orientated along the line of centres. The repulsive corrections proportional to $1/R^5$ and $1/R^7$ found by Penfield and Zatskis (Abstr. 5879/1957) are considered in conjunction with the complete corrections obtained by Casimir and Polder (Abstr. 1286/1948) in a realistic model. It is shown that in the limit of electrodynamic interest, i.e. separations large compared with the wavelength corresponding to the harmonic oscillator frequency, the total force is attractive and proportional to $1/R^8$. The Penfield and Zatskis correction, valid at near distances only, is dominated by the static London $1/R^7$ attraction. A.

539.18 : 537.583

3406. DETERMINATION OF THE ELECTRON AFFINITY ENERGY OF SULPHUR ATOMS BY THE METHOD OF SURFACE IONIZATION. I.N.Bakulina and N.I.Ionov.
Dokl. Akad. Nauk SSSR, Vol. 116, No. 1, 41-4 (1957). In Russian.

An improved measurement of the affinity is obtained from measurements of the surface currents from the negative ions of NaBr and Na_2S in the temperature range 1800-2300° K. They lead to value $s = 2.37$ eV. S.F.Edwards

MOLECULES

539.19 : 535.343

3407. SPECTRA OF THE PARACYCLOPHANES. L.L.Ingraham.
J. chem. Phys., Vol. 27, No. 5, 1228-9 (Nov., 1957).

Theoretical discussion of the differences between the spectrum of di-para-xylylene and that of an alkylated benzene. The lack of fine structure and the shift of the 260 mμ band are ascribed to ring strain, and shoulders at 240 mμ and 300 mμ are ascribed to interaction between the two rings. J.Hawgood

539.19

3408. COMPARATIVE STUDY OF POTENTIAL ENERGY FUNCTIONS FOR DIATOMIC MOLECULES. Y.P.Varshni.
Rev. mod. Phys., Vol. 29, No. 4, 664-82 (Oct., 1957).

A survey is presented of fifteen published potential energy functions for diatomic molecules, and seven new functions. These were tested using values for twenty three diatomic molecules for which accurate data are available. The relative accuracy of the functions for estimating α_e and $\omega_e x_e$ is compared. Best values are obtained from:

$$\alpha_e = (0.11\Delta + 0.36)6B_e^2/\omega_e,$$

$$\omega_e x_e = (5\Delta + 9)W/r_e^2\mu_A,$$

and

$$D_e = \frac{5Wk_e r_e^4}{2\omega_e x_e r_e^2 \mu_A - 9W},$$

where $W = 2.1078 \times 10^{-16}$, B_e is a rotational constant, and Δ the Sutherland parameter ($k_e r_e^2/2D_e$). All other terms have the meaning usual in this field. R.C.Seymour

539.19

3409. WAVE FUNCTIONS FOR THE METHANE MOLECULE. I.M.Mills.
Molecular Phys., Vol. 1, No. 2, 99-106 (April, 1958).

If the potential field due to the nuclei in the methane molecule is expanded in terms of a set of spherical harmonics about the carbon nucleus, only the terms involving s, f, and higher harmonic functions differ from zero in the equilibrium configuration. Wave-functions are calculated for the equilibrium configuration, first including only the spherically symmetric s term in the potential, and secondly including both the s and the f terms. In the first calculation the complete Hartree–Fock S.C.F. wave-functions are determined; in the second calculation a variation method is used to determine the best form of the wave-function involving f harmonics. The resulting wave-functions and electron density functions are presented and discussed. A.

539.19

3410. VIBRATIONAL INTENSITIES IN METHANE. I.M.Mills.
Molecular Phys., Vol. 1, No. 2, 107-22 (April, 1958).

The absorption intensities of the two infrared active vibrations in methane are obtained from a perturbation calculation on the equilibrium wave-functions derived in the preceding abstract. The perturbation field is the change in the potential field due to the nuclei which results from moving the nuclei in the vibrational coordinate concerned, and a simplified form of second order perturbation theory, developed by Pople and Schofield, is used for the calculation. The main approximation involved is the neglect of f and higher harmonics in the spherical harmonic expansion of the nuclear field. The resulting dipole moment derivatives are approximately three times larger than the experimental values, but they show qualitative features and sign relationships which are significant. The experimental intensity measurements are interpreted and discussed in relation to these results. A.

539.19

3411. INTRAMOLECULAR AND INTERMOLECULAR COUPLING OF CH_2 ROCKING MODES IN N-PARAFFINS. R.G.Snyder.
J. chem. Phys., Vol. 27, No. 4, 969-70 (Oct., 1957).

Infrared spectra measured at -160°C, of pure n-paraffins C_{20}–C_{39}, show that other CH_2 rocking modes beside the characteristic mode at 725 cm^{-1}, exhibit splitting, and the pattern of splitting is dependent upon the crystal structure of the n-paraffin. R.C.Seymour

539.19

3412. VIBRATIONAL RELAXATION TIMES IN NITROGEN. S.J.Lukasik and J.E.Young.
J. chem. Phys., Vol. 27, No. 5, 1149-55 (Nov., 1957).

By means of a technique involving an acoustical resonant cavity, the vibrational relaxation time in nitrogen was measured at 1186, 1020, 778°K. The lifetime of an excited vibrational level in nitrogen at the above temperatures is found to be 2.29×10^6, 4.55×10^6, 6.55×10^6 collisions, respectively. These results are in good agreement with shock-tube measurements of Blackman in the temperature range of 3500-5600°K. The effect of water vapour on the relaxation time is discussed. Previous measurements by Huber and Kantrowitz are shown to have been affected by water vapour impurities; the present measurements are believed to be relatively free from this effect since the concentration of water vapour was at most 0.005%. A.

539.19

3413. ISOTOPE EFFECT ON THE MEAN-SQUARE AMPLITUDE [OF MOLECULAR VIBRATION]. K.Kimura.
J. chem. Phys., Vol. 27, No. 5, 1213-14 (Nov., 1957).

Describes a simple approximation for calculating this effect, which is useful for an atom pair including an H atom, unlike the method of Abstr. 1524 (1954). J.Hawgood

539.19

3414. ON ASYMMETRIC ROTORS. G.W.Robinson.
J. chem. Phys., Vol. 27, No. 5, 1227-8 (Nov., 1957).

Criticizes the formulation used in the tables of energy levels due to King, Hainer and Cross (1943), and describes an alternative formulation better suited to nearly symmetric rotors, which starts from the same numerical tables. J.Hawgood

539.19

3415. EFFECT OF CHANGE IN MOMENT OF INERTIA ON THE INTENSITY DISTRIBUTION IN P AND R BRANCHES OF $C_{\infty v}$ MOLECULES. G.A.Gallup.
J. chem. Phys., Vol. 27, No. 6, 1338-40 (Dec., 1957).

The effect of the change in moment of inertia part of the interaction between vibration and rotation on the intensities of parallel bands of linear polyatomic molecules is determined to the first order. The results are quite similar to those of Herman and Wallis (Abstr. 5317/1955) for diatomic molecules. The interaction term depends on among others a quantity, ξ_k, different in general for each band. Perpendicular bands do not show a first-order correction. A "sum rule" for the ξ_k is determined. A.

539.19

3416. RESONANCE IN STERICALLY HINDERED AROMATIC MOLECULES. F.J.Adrian.
J. chem. Phys., Vol. 28, No. 4, 608-16 (April, 1958).

Many aromatic molecules, typical of which are the triphenylmethyl radical and cis-stilbene, cannot have the planar structure which would maximize the resonance energy, because of steric hindrance. A semi-empirical method of treating such molecules is developed. It is assumed that the primary effect of the steric strain is to rotate the phenyl groups out of the plane of the molecule. The resulting reduction in resonance energy is estimated using the valence-bond method. The steric interaction energies are calculated using a method of Eyring, based on the "perfect pairing approximation" of valence bond theory. A plot of the sum of these two energies v. twist angle gives the equilibrium configuration, and the effective resonance energy of the molecule. The triphenylmethyl radical has a predicted twist angle of 32°, and is stabilized partly by its resonance energy and partly by steric strain in hexaphenylethane. The theoretical twist angle for the free radical di-p-anisyl nitric oxide is 25°, as compared with an experimental result of 33°. A close balance between steric strain and resonance in biphenyl leads to virtually free rotation about the central bond. Finally, it is shown that steric hindrance accounts for the energy difference between the cis- and trans-isomers of stilbene and azobenzene. A.

539.19 : 539.2

INTERMOLECULAR AND INTRAMOLECULAR VIBRATIONS IN CRYSTALS. See Abstr. 3449

539.19 : 535.343

3417. THEORY OF INDUCED INFRA-RED ABSORPTION. J.van Kranendonk.
Physica, Vol. 23, No. 9, 825-37 (Sept., 1957).

A general formalism is developed for the calculation of the density and temperature dependence of the intensity of forbidden rotation–vibration bands that are induced by the intermolecular forces. Expressions are derived for the integrated absorption coefficients, and a qualitative discussion is given of the translational absorption arising from the dependence of the induced dipole moments on the intermolecular separations. The expansion of the total integrated absorption coefficient in powers of the density is given, expressions are derived for the binary and ternary absorption coefficients appearing in this expansion, and the interference effects occurring in the absorption due to clusters of three and more molecules are discussed. Expressions for the integrated absorption coefficients corresponding to definite rotational transitions, and their density expansions, are also given. The concepts of single and double transitions are introduced, and the interference effects are shown to appear only for single transitions. A.

539.19

3418. RENNER EFFECT IN POLYATOMIC MOLECULES.
K.Dressler and D.A.Ramsay.
J. chem. Phys., Vol. 27, No. 4, 971-2 (Oct., 1957).

In the Renner effect a parameter ϵ measures the interaction between electronic and vibrational angular momentum. For a given vibrational quantum number large splittings can result between the sub-levels, and for large ϵ these splittings can be larger than the vibrational intervals. Such large splittings occur in the electronic absorption spectrum of NH_2 which involves a transition from a bent ground state to a linear excited state. It is suggested that this transition should be written $^2A_1\Pi_u \leftarrow {}^2B_1$ (Mulliken's definition of B_1), the electronic origin of the band system being equal to the barrier height of the ground state with respect to bending. Further spectra of the same type are expected for HCO, CH_2^+, BH_2, H_2O^+.

R.C.Seymour.

539.19

3419. THE POLYGON METHOD FOR THE GRAPHICAL STUDY OF DETERMINANTS. APPLICATIONS TO PROBLEMS OF THEORETICAL CHEMISTRY. I.Samuel.
Cahiers de Phys., Vol. 11, 441-88 (Dec., 1957). In French.

A thesis is presented describing in detail the system for evaluating determinants briefly given in Abstr. 2614 (1950). The method uses the mathematical as well as the molecular symmetry to simplify the solution of a secular equation. Many examples of applications to aromatic and heterocyclic molecules are given.

J.Hawgood

539.19

3420. INTENSITY OF THE SYMMETRY-FORBIDDEN ELECTRONIC ABSORPTION BAND OF FORMALDEHYDE.
J.A.Pople and J.W.Sidman.
J. chem. Phys., Vol. 27, No. 6, 1270-7 (Dec., 1957).

The weak bands of formaldehyde extending from λ 3500 A to λ 2300 A are normally assigned to a $^1A_2 \leftarrow {}^1A_1$, $n \rightarrow \pi$ transition (C_{2v} symmetry) which is forbidden by electronic selection rules. The present paper gives a quantitative theoretical discussion of the total intensity of these bands in each of the three directions of polarization. Using approximate wave-functions for the various electronic states involved, the theory shows that the intensity of the perpendicular bands can be accounted for by vibrationally-induced mixing of excited electronic states. The calculated total intensity due to this mechanism is $f = 3 \times 10^{-4}$. It is predicted that most of this intensity is produced by the out-of-plane bending vibration and is consequently polarized perpendicular to the C—O axis and in the molecular plane (B_1 polarized). The contribution due to in-plane vibrations (CH_2 wagging and antisymmetric C—H stretch), which would be polarized perpendicular to the molecular plane (B_2 polarized), is predicted to be much weaker. This is in agreement with experiment. The weak parallel bands that have been observed cannot be interpreted in terms of vibrational-electronic interaction. It is suggested that these derive their intensity by borrowing, induced by rotation around the C—O axis, from the strong $^1A_2 \leftarrow {}^1A_1$, $\pi \rightarrow \pi$ transition. A quantitative theory of this effect gives $f \sim 10^{-6}$ for the total oscillator strength of the parallel bands. Several predictions which might be tested experimentally are made on the basis of this hypothesis. A.

539.19

3421. ELECTRONIC ENERGY OF LiH AND BeH.
J.Miller, R.H.Friedman, R.P.Hurst and F.A.Matsen.
J. chem. Phys., Vol. 27, No. 6, 1385-7 (Dec., 1957).

Valence bond calculations for LiH and BeH^+ have been completed. All twenty structures which can be written for 1s, 2s, and $2p_\sigma$ on the metal atom and 1s on hydrogen are considered. It was found that only six structures are of importance and that promotion of inner shell 1s electrons adds nothing to the description. The results for LiH agree well with those obtained by previous workers. A.

539.19

3422. H.F.S. OF THE H_2S MOLECULE AND ITS ELECTRONIC STRUCTURE. K.Ohno, Y.Mizuno and M.Mizushima.
J. chem. Phys., Vol. 28, No. 4, 691-3 (April, 1958).

The observed h.f.s. coupling constant of the H_2S^{33} molecule shows a large asymmetry although the H—S—H bond angle is known to be almost 90°. It is shown that a nonzero d character of the S—H bond orbital can explain this result. Assuming that the electron distribution is cylindrically symmetric about each S—H bond, and the radial part of the p- and d-wave-functions are the same, 10.$_5$% s character, 73.$_5$% p character, and 16% d character is concluded for the bond orbital; 23% p character and 77% s character is assigned for the lone pair. If the ionic structure is neglected, the electric quadrupole moment of the S^{33} nucleus is estimated to be -0.11×10^{-24} cm^2. A.

539.19

3423. HYBRIDIZATION IN THE GROUND STATE OF THE HYDROGEN MOLECULE-ION.
B.F.Gray, H.O.Pritchard and F.H.Sumner.
J. Chem. Soc., 1956, 2631-5 (Aug.).

Calculations were made on an automatic machine to determine the best representation of the ground state of the hydrogen molecule-ion in terms of a linear combination of the ten hydrogen-atom wave functions 1s, 2s, 2p, 3s, 3p, 3d, 4s, 4d, 4f. An error in some earlier calculations was noted and it was found that, if the effective value of Z is maintained at unity, the best function gives only about 75% of the experimental dissociation energy. With the inclusion of a single value of Z as a variation parameter, it is possible to get a close approximation to the true dissociation energy. A feature of the calculation is that the necessary two-centre integrals were, for the most part, evaluated in an analytical fashion by the machine. A.

539.19

3424. PARAMAGNETIC RESONANCE OF THE REACTION PRODUCTS OF THE FREE RADICAL TRI-p-NITROPHENYLMETHYL AND OXYGEN. F.M.Schimmel and F.W.Heineken.
Physica, Vol. 23, No. 8, 781-4 (Aug., 1957).

Paramagnetic resonance of the free radical tri-p-nitrophenylmethyl was measured at a frequency of 9000 Mc/s. By admitting air to the sample placed in the cavity in the magnet gap, a second resonance absorption is observed. A possible explanation is given and some suggestions for future research are made. A.

539.19

3425. NUCLEAR RESONANCE SPECTRA OF RAPIDLY INTERCONVERTING ROTATIONAL ISOMERS.
D.M.Graham and J.S.Waugh.
J. chem. Phys., Vol. 27, No. 4, 968-9 (Oct., 1957).

Small splittings δ in the proton resonance spectra of ethane-like molecules are shown to arise from rotational isomerism. This is supported by measurements of the temperature dependence of δ, which decreases with increasing temperature. R.C.Seymour

539.19

3426. F^{19} NUCLEAR MAGNETIC SHIELDING IN FLUORONAPHTHALENES. T.Isobe, K.Inukai and K.Ito.
J. chem. Phys., Vol. 27, No. 5, 1215-16 (Nov., 1957).

Measurements are reported of the chemical shift of the fluorine nuclear magnetic resonance in α- and β-fluoronaphthalene and fluorobenzene. The authors discuss the fact that the fluorine nucleus is more shielded in the naphthalene derivatives than in fluorobenzene, although protons in the same positions are less shielded than in benzene. J.M.Baker

539.19

3427. NUCLEAR MAGNETIC RESONANCE AND ROTATIONAL ISOMERISM IN SUBSTITUTED ETHANES. J.A.Pople.
Molecular Phys., Vol. 1, No. 1, 3-8 (Jan., 1958).

Deals with the classification of high-resolution nuclear magnetic resonance spectra of substituted ethanes and similar molecules. In particular, the forms of the spectra for individual rotational isomers of long lifetime are compared with those appropriate to rapid internal conversion. The use of nuclear resonance data to deduce information about the rate of internal rotation is discussed in detail. A.

539.19

3428. FE THEORY INCLUDING AN ELASTIC σ SKELETON. I. SPECTRA AND BOND LENGTHS IN LONG POLYENES. H.Labhart.
J. chem. Phys., Vol. 27, No. 4, 957-62 (Oct., 1957).

FE theory is refined by introducing the interaction between π electrons and an elastic σ skeleton. It is shown that even for very long polyenes a difference in single and double bond length of the same order of magnitude as in shorter polyenes is to be expected. Bond lengths in the ground and first excited state are calculated, which compare favourably with experimental data deduced by a Franck—Condon analysis of the intensities of vibrational peaks. A.

539.19

3429. FE THEORY INCLUDING AN ELASTIC σ SKELETON. II. CHANGES OF MOLECULE DIMENSIONS DUE TO OPTICAL EXCITATION. H.Labhart.
J. chem. Phys., Vol. 27, No. 4, 963-5 (Oct., 1957).

For Pt I see preceding abstract. A simple theory is given which relates the changes in molecular dimension due to optical excitation to the changes in kinetic energy and interaction energy of π-electrons. Results for polyenes, polymethines, and for benzene are given. The latter agree quite satisfactorily with experimental determinations. A.

539.19

3430. ELECTRONEGATIVITY OF RADICALS. A METHOD OF CALCULATION. J.K.Wilmshurst.
J. chem. Phys., Vol. 27, No. 5, 1129-31 (Nov., 1957).

Gordy's expression, relating the electronegativity of an atom with the number of electrons in the valence shell and the covalent bond radius, is extended to the calculation of the group electronegativity of a radical. Both the state of hybridization and the effect of the electronegativity property of other atoms on the bonding atom in the radical are accounted for. The group electronegativities calculated by this expression are in agreement with those obtained from the "sensitive" CH bending vibrational frequencies, but disagree with group electronegativities obtained from other spectroscopic data. The causes of these differences are discussed. A.

539.19 : 541.124

3431. MO-THEORETICAL APPROACH TO THE MECHANISM OF CHARGE TRANSFER IN THE PROCESS OF AROMATIC SUBSTITUTIONS. K.Fukui, T.Yonezawa and C.Nagata.
J. chem. Phys., Vol. 27, No. 6, 1247-58 (Dec., 1957).

An MO-theoretical investigation on the mechanism of aromatic substitution is made. Supposing that the approaching reagent and the atom to be replaced can be treated as an atom (pseudoatom) which has a π-type orbital in the course of reaction, an important role of hyperconjugation taking place between the pseudoatom and the aromatic compound is remarked. Since the electron density at the pseudoatom relates to the amount of charge transfer through this hyperconjugation and varies as the reaction proceeds, the proceeding of the reaction can be measured by this electron density. Then, the electron density is expressed, in the form of a contour diagram, in terms of the Coulomb integral of the pseudoatom and the resonance integral between the pseudoatom and carbon atom to be attacked. Thus, a reaction path can be represented by a locus plotted on this diagram. The discriminating property of frontier orbitals can be observed in this diagram. It has been confirmed that an electrophilic, or a nucleophilic, substitution takes place only when a certain condition is satisfied with respect to the energy of the reagent. By determining the transition state which corresponds to the end point of the locus, several reactivity indices, i.e., frontier electron density, superdelocalizability, its one-term approximation and a generalized reactivity index are derived from the hyperconjugation energy at the transition state, which is also available as a generalized reactivity index. Correlation between these and the existing indices is examined. A.

539.19

3432. ELECTRON–ELECTRON SEPARATION IN MOLECULAR HYDROGEN. M.P.Barnett, F.W.Birss and C.A.Coulson.
Molecular Phys., Vol. 1, No. 1, 44-7 (Jan., 1958).

Calculations of the mean distance and mean inverse distance between the electrons in the hydrogen molecule show that a Heitler–London wave-function exhibits more correlation and a molecular orbital function less correlation than a covalent-ionic wave-function. Introduction of an atomic screening constant decreases the mean distance between the electrons. A.

539.19 : 535.343

3433. ATOMIC POLARIZATION AND INFRA-RED ABSORPTION. D.H.Whiffen.
Trans Faraday Soc., Vol. 54, Pt 3, 327-9 (March, 1958).

It is shown that the atomic polarization of a molecule is related to its infrared absorption intensities by the relation $P_A = (Nc/3\pi^2)\Sigma_j A_j/\nu_j^2$ and this formula is used to obtain the atomic polarizations of molecules. A.

539.19

3434. STRUCTURE AND MOLECULAR INTERACTION IN HX–DX MIXED CRYSTALS. D.F.Hornig and G.L.Hiebert.
J. chem. Phys., Vol. 27, No. 3, 752-7 (Sept., 1957).

The infrared spectra of mixed HCl–DCl and HBr–DBr crystals were studied at 66°K in their lowest temperature crystalline phase over the entire composition range. It is demonstrated quantitatively that the observed spectra are those of linear zigzag chains in both cases. The magnitude of the interaction constant between displacements of neighbouring molecules suggests that in the crystal $\partial\mu/\partial r$ is about 2d/A for both molecules, more than twice the value in the free molecule. A.

539.19

3435. NOTE ON THE DETERMINATION OF MOLECULAR STRUCTURE FROM SPECTROSCOPIC DATA. V.W.Laurie.
J. chem. Phys., Vol. 28, No. 4, 704-6 (April, 1958).

The problem of the change upon isotopic substitution of "effective" bond lengths and angles involving hydrogen is considered. Evidence is presented that in certain cases such variation is largely due to vibration of the heavy atoms rather than of the hydrogens. A method of calculating this effect is presented which utilizes a parameter similar to the "quantum defect" $\Delta_v = I_c - I_a - I_b$ observed in planar molecules. Estimates are given of the changes to be expected in effective hydrogen parameters upon isotopic substitution. Bond angles are found to slightly increase and bond lengths are found to decrease. A.

539.19

3436. THE CALCULATION OF THE MAGNETIC PROPERTIES OF MOLECULES USING THE METAL MODEL METHOD. T.K.Rebane.
Vestnik Leningrad. Univ. Ser. Fiz. Khim. No. 3 (1957) No. 16, 19-31. In Russian.

The author establishes the form of a one-dimensional Hamiltonian for the metallic model of a molecule in the case of a uniform magnetic field and then, using the continuity conditions at the lattice junctions, derives a method of calculating the magnetic properties of π-electrons in aromatic molecules. The method is shown to lead to results close to those obtained by the molecular-orbit method. C.R.S.Manders

539.19

3437. STRUCTURE OF GASEOUS CHLOROPICRIN AS DETERMINED BY ELECTRON DIFFRACTION. W.M.Barss.
J. chem. Phys., Vol. 27, No. 6, 1260-6 (Dec., 1957).

The structure of chloropicrin was studied as a step in the investigation of several families of methane derivatives to determine variations in carbon bond angles and bond lengths in compounds having approximately tetrahedral carbon bonds. The results obtained showed the carbon–nitrogen bond to be longer in chloropicrin than in either nitromethane or tetranitromethane. The electron diffraction patterns were obtained in a camera in which high background intensity gradients were corrected by means of a rotating shutter intercepting the scattered electrons. Intensity curves derived from microphotometer traces were subjected to Fourier analysis to obtain a radial distribution function. Intensity curves were synthesized for a series of molecular models to make a refined determination of the molecular parameters for chloropicrin. A.

539.19

3438. REINVESTIGATION OF THE MOLECULAR STRUCTURE OF 1,3,5,7-CYCLOOCTATETRAENE BY ELECTRON DIFFRACTION. O.Bastiansen, L.Hedberg and K.Hedberg.
J. chem. Phys., Vol. 27, No. 6, 1311-17 (Dec., 1957).

The molecular structure was studied by a sector-microphotometer technique using data extending to very much larger scattering angles than were obtained in earlier investigations. An application of the method of least squares to sector-microphotometer data in electron diffraction worked out by one of the authors has led in three refinement stages to unusually precise values for the parameters. The following are the more interesting parameter values with standard errors. It should be noted these results do not include a possible error of up to 0.2% in the scale of the molecule because of uncertainties in the electron wavelength, nor do they include the effect of correlations among the observations on the standard errors, which it is estimated might increase the standard errors by as much as the factor $2^{1/2}$. Molecular symmetry D_{2d}, C=C = 1.334 ± 0.001A, C–C = 1.462 ± 0.001A, C–H = 1.090 ± 0.005A, ∠C=C–C = 126.46° ± ± 0.23°, ∠C=C–H = 118.3° ± 5.9°, $a_{C=C}(=\langle\delta l^2\rangle_{C=C}/2) = (103 \pm 7) \times \times 10^{-5}$, $a_{C-C} = (147 \pm 10) \times 10^{-5}$, $a_{C_1\cdots C_3} = (256 \pm 13) \times 10^{-5}$, $a_{C_1\cdots C_4} = (530 \pm 100) \times 10^{-5}$, $a_{C-H} = (327 \pm 36) \times 10^{-5}$, $a_{C_2\cdots H} = (520 \pm 110) \times 10^{-5}$, $a_{C_3\cdots H} = (640 \pm 180) \times 10^{-5}$. A.

539.19

3439. ELECTRON DIFFRACTION INVESTIGATION OF THE MOLECULAR STRUCTURE OF HALIDES OF ELEMENTS OF GROUP II OF MENDELEEV'S PERIODIC SYSTEM. P.A.Akishin and V.P.Spiridonov.
Kristallografiya, Vol. 2, No. 4, 475-83 (1957). In Russian.

The study was carried out using electron diffraction in the gas phase; a description is given of the apparatus and the method. Interatomic distances are tabulated for the halides of Be, Mg, Ca, Sr, Ba, Zn, Cd, and Hg; estimates of the covalent radii of these elements are also tabulated. R.F.S.Hearmon

539.19

3440. INTERNUCLEAR DISTANCE AND L-TYPE DOUBLING IN CARBON DISULFIDE. A.H.Guenther, T.A.Wiggins and D.H.Rank.
J. chem. Phys., Vol. 28, No. 4, 682-7 (April, 1958).

The 003-000 and 01^13-01^10 bands of CS_2 were measured with

high precision. It has been possible to derive a very precise value of the CS distance, $r_e = 1.5532 \pm 0.0005$ A. The values obtained for the molecular constants were $B_{000} = 0.109\,09_9 \pm 0.000\,023$, $\alpha_2 = -0.000\,256$, $\alpha_3 = +0.000\,711$, all quantities expressed in cm^{-1}. The mean measured value of q was found to be 6.6×10^{-5} cm^{-1} which can be compared to a theoretically predicted value of 7.8×10^{-5} cm^{-1}. A.

539.19

3441. ON THE CHANGE IN THE CHARACTER OF A CHEMICAL BOND WITH CHANGE IN COORDINATION NUMBER.
S.S.Batsanov and V.I.Pakhomov.
Kristallografiya, Vol. 2, No. 1, 183-6 (1957). In Russian.

Estimates are made of the radius of Na, K, Rb, Cs, F, Cl, Br atoms as affected by degree of ionization. The effect of ionization on the interatomic distances in certain of the alkali halides is also estimated. R.F.S.Hearmon

539.19 : 533.7

3442. UNLIKE MOLECULAR INTERACTIONS AND PROPERTIES OF GAS MIXTURES. K.P.Srivastava.
J. chem. Phys., Vol. 28, No. 4, 543-9 (April, 1958).

Recently the author (Abstr. 8744/1957) developed a set of semi-empirical combination rules which may be utilized to calculate the intermolecular potentials for unlike pairs of molecules from the known potentials for like pairs on the modified Buckingham exp-six model. It is, therefore, necessary to see how far these combination rules can reproduce the transport properties of binary gaseous mixtures over large ranges of temperature and concentration. With this end in view various transport properties such as thermal diffusion, interdiffusion, thermal conductivity, and viscosity have been calculated for a large number of binary mixtures and the computed values compared with the experimental data. It is found that the agreement between the theory and experiment is quite satisfactory. It is concluded that this set of combination rules can be used with success to predict the transport properties of gaseous mixtures within the limits of experimental error. A.

539.19 : 539.2

3443. DIRECT MEASUREMENT OF THE LONG-RANGE VAN DER WAALS FORCES. J.A.Kitchener and A.P.Prosser.
Proc. Roy. Soc. A, Vol. 242, 403-9 (Nov. 5, 1957).

There exists a serious discrepancy in published values for the directly determined van der Waals force between macroscopic bodies, the result of Deryagin and Abrikosova (Abstr. 5944/1952, 8475/1954, 8109/1955, 8303/1956 and 571-2/1957) being smaller by a factor of approximately 500 than those of Overbeek and Sparnaay (Abstr. 3766/1952, 3481/1953, 8107/1955). This could have important implications in the quantitative theory of colloids. Some independent determinations have therefore been carried out to resolve this anomaly. Determinations of the force of attraction between parallel, optically flat glass plates in vacuo have been carried out at distances of separation ranging from 0.7 to 1.2 μ. The method was similar in principle to that of Overbeek and Sparnaay but of improved sensitivity. The force, which ranged from 10^{-2} to 10^{-3} dyn.cm^{-2}, was determined by measuring the deflection of a spring, using an electrical capacity method; the distance between the plates was obtained from interference colours produced from the relfection of white light. Particular attention was paid to elimination of any effect of electrostatic charges on the plates. The results definitely confirm the work of Deryagin and Abrikosova. The agreement is particularly satisfactory in that a different experimental method was employed, with bodies of different shape and with different methods of discharging the plates. Further, the results prove that the retarded dispersion force is operative at the above distances. A.

SOLID-STATE PHYSICS

539.2

3444. INTERNATIONAL CONFERENCE ON CURRENT PROBLEMS IN CRYSTAL PHYSICS. J.C.Slater.
Rev. mod. Phys., Vol. 30, No. 1, 46 (Jan., 1958).

The Conference was held at the Massachusetts Institute of Technology in July 1957. It was organized by the Commission on the Physics of Solids of the International Union of Pure and Applied Physics with the assistance of international and U.S. bodies. 29 papers from this Conference are published in Rev. mod. Phys., Vol. 30, No. 1, 47-255 (Jan., 1958) and their abstracts will be found under appropriate headings.

539.2

3445. INTERACTION OF WAVES IN CRYSTALS. J.C.Slater.
Rev. mod. Phys., Vol. 30, No. 1, 197-222 (Jan., 1958).

A review is presented from a unified standpoint of the principles underlying the theories of various processes of interaction of photons, phonons, electrons, neutrons, etc., in crystals. Topics treated include ordinary diffraction and thermal diffuse scattering of X-rays, electrons and neutrons; the scattering of light by ultrasonic waves; energy band theory; electrical and thermal conductivity; and thermal vibrations of crystals. There is a useful bibliography of about 300 references, mainly on X-ray and electron diffraction. J.Hawgood

539.2

3446. LATTICE DYNAMICS AND THERMAL DIFFUSE SCATTERING OF X-RAYS. E.H.Jacobsen.
Rev. mod. Phys., Vol. 30, No. 1, 234-5 (Jan., 1958).

Some general remarks are made on the relation between X-ray diffuse scattering and crystal vibrations. A.R.Stokes

539.2

3447. DYNAMICS OF A CRYSTAL LATTICE CONTAINING ISOTOPES. J.Pirenne.
Physica, Vol. 24, No. 2, 73-92 (Feb., 1958).

By means of a moment method, the vibration spectrum of a monoatomic crystal containing several isotopes, whose atoms are distributed at random throughout the lattice points, is obtained in terms of the solution of the conventional vibration problem of a single isotope crystal and in terms of the quantities

$$\langle \Delta\mu^p \rangle_{Av} = \Sigma_i c_i \Delta\mu_i{}^p = \Sigma_i c_i (\mu_i - \langle\mu\rangle_{Av})^p,$$

where c_i is the concentration of the i-th isotope and $\Delta\mu_i$ the deviation of its inverse atomic mass μ_i from the average value $\langle\mu\rangle_{Av} = \Sigma_i c_i \mu_i$. The frequency distribution is represented by a series development following the increasing powers of a heterogeneity parameter to which all the $\Delta\mu_i$ are assumed to be proportional. The first term is the frequency distribution of a fictious crystal whose atoms would all have the mass $\langle\mu\rangle_{Av}^{-1}$. The next two terms are proportional to $\langle\Delta\mu^2\rangle_{Av}$ and $\langle\Delta\mu^3\rangle_{Av}$; the fourth term brings contributions in $\langle\Delta\mu^4\rangle_{Av}$ and in $\langle\Delta\mu^2\rangle^2$, etc. These three additional terms have been written down explicitly, but the following ones could be easily obtained. Each term but the first one brings contributions of the form $\int\delta'(\lambda - \lambda')\, K(\lambda')\, d\lambda'$, where λ is the square of the angular frequency. These functionals may not be simply put equal to $K'(\lambda)$, as $K(\lambda)$ has singularities which must be carefully considered. In thermodynamic applications, however, this difficulty is irrelevant for then the δ' function is simply replaced by the λ-derivative of the desired thermodynamic function of the harmonic oscillator and the remaining integral is trivial. A.

539.2 : 539.19

3448. THE INTERACTION OF INTRAMOLECULAR AND LATTICE OSCILLATIONS OF CRYSTALS FROM INFRARED SPECTRAL DATA. E.F.Gross and A.A.Shultin.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 4, 689-92 (1957). In Russian.

Infrared transmission spectra were measured for single-crystal specimens of $Ba(NO_3)_2$ and $Pb(NO_3)_2$ at -160° C and 20° C. The NO_3 groups have 6 normal modes of vibration with wave-numbers from 700 to 1500 cm^{-1}. Satellites to these bands were recorded and identified as corresponding to lattice interactions. A.L.Mackay

539.2 : 539.19

3449. THE RELATIONSHIP BETWEEN INTERMOLECULAR AND INTRAMOLECULAR VIBRATIONS IN CRYSTALS. N.N.Porfir'eva.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 47-52 (1957). In Russian.

A model of a molecular crystal with "semi-rigid" molecules is examined. The conditions for separation of intermolecular and intramolecular vibrations are investigated. As an example a two-dimensional lattice of C_{4v} symmetry is considered. A.

539.2

3450. THEORY OF ANISOTROPIC CUBIC CRYSTALS. N.A.Potapkov.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 6, 965-6 (1957). In Russian.

The electromagnetic field matrix is set up for an anisotropic cubic crystal and its interaction Hamiltonian with electron spin operators is formulated. From this the polarizability is calculated. J.W.Gardner

539.2

3451. ON THE OPTICAL PROPERTIES OF SOLIDS. II. H.B.Rosenstock.
J. chem. Phys., Vol. 27, No. 5, 1194-201 (Nov., 1957).

For previous part see Abstr. 2542 (1956). The absorption of light by a crystal due to atomic motion is calculated by first-order perturbation theory in the approximation in which atoms are considered as charged mass points. The effect of each normal oscillator is shown to depend on the value of a sum over normal mode transformation coefficients which becomes identical with the dipole moment associated with the oscillator when the crystal is small compared to the longest absorbed wavelength. To get results in terms of frequency, this expression must be weighted by the density of states of the normal oscillators. The general results are evaluated for the case of a simple model of an ionic crystal; in addition to the strong absorption peak at the "limiting frequency", peaks at frequencies corresponding to critical points of the constant energy surfaces in k space are shown to appear provided boundary conditions are taken into account, and the effects of crystal size are shown to enhance the importance of these subsidiary peaks. The bearing of these effects on other optical properties, and on the impurity problem, is discussed briefly. A.

539.2

3452. EQUATION OF STATE OF SOLIDS. S.S.Tolpadi.
J. sci. Res. Banaras Hindu Univ., Vol. 7, No. 1, 143-8 (Dec., 1956).

That proposed (Abstr. 7364/1956) is compared with Bridgman's data for Ag, Au, Pt, Cu and W, with good agreement at pressures of 1-40 Kbars. P.Gray

539.2

3453. ON DETERMINING THE SHAPE OF THE FERMI SURFACE. R.A.Coldwell-Horsfall and D.ter Haar.
Physica, Vol. 23, No. 12, 1126-30 (Dec., 1957).

It is suggested that the conductivity tensor may give useful information about the shape of the Fermi surface. A.

539.2

3454. THE POLAR MODEL OF A METAL. I.Z.Fisher.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 262-3 (1957). In Russian.

The polar model of a metal introduced by Vonsovskiĭ (Uspekhi fiz. Nauk, Vol. 48, 289, 1952) is discussed by relating the degree of polarization to the fluctuations of the electron density. S.F.Edwards

539.2 : 539.12

3455. MULTIPHONON PROCESSES IN CRYSTALS. V.F.Turchin.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 124-31 (1957). In Russian.

The differential cross-sections for inelastic scattering of neutrons in a crystal involving emission of an arbitrary number of phonons and also for inelastic scattering of neutrons involving absorption of an arbitrary number of phonons are computed. The first of these quantities is of interest when the temperature of the crystal is low and the second — when the neutron energy is very low and the temperature of the crystal is sufficiently high. Formulae were obtained for a crystal with an arbitrary normal vibration spectrum. For a particular choice of the spectrum the calculations can be carried out to simple final formulae. A limiting transition to scattering on a free nucleus at high neutron energies is also carried out. A.

539.2

3456. IONIZATION OF EXCITONS IN A Cu_2O CRYSTAL BY AN ELECTRIC FIELD. E.F.Gross and B.P.Zakharchenya.
Zh. tekh. Fiz., Vol. 28, No. 2, 231-2 (1958). In Russian.

539.2

3457. ON MULTIELECTRON THEORY OF IONIC CRYSTALS. M.Sh.Giterman.
Fiz. Metallov i Metallovedenie, Vol. 5, No. 2, 364-7 (1957). In Russian.

Generalization of calculation of spectra of elementary excitations in atomic semiconductors (S.V.Vonsovskiĭ, Yu.P.Irkhin, A.N.Kushnirenko and E.A.Turov, Fiz. Metallov i Metallovedenie, Vol. 3, 385, 1956) to the case of ionic crystals.

539.2

3458. ELECTRON TRANSPORT IN METALS. M.Tsuji.
J. Phys. Soc. Japan, Vol. 12, No. 7, 828-9 (July, 1957).

Outlines a calculation of the conductivity σ and thermoelectric power S using the Bohm–Pines E_k curve (Abstr. 1279/1954) instead of the usual parabola. Formulae are given for the general case of arbitrary temperatures and impurity concentrations. A mistake is pointed out in Barrie's more restricted calculation (Abstr. 567/1957). Numerical results are given for the alkali metals and in no case do σ and S deviate largely from their values for parabolic bonds. D.M.Edwards

539.2

3459. ELECTRONIC CONFIGURATION OF CATIONS IN SOME DISTORTED SPINELS. K.P.Sinha.
Nature (London), Vol. 181, 835-6 (March 22, 1958).

Considers the electronic configuration of cations in Mn_3O_4 and Mn_2O_3. A.R.Stokes

539.2

3460. THE ELECTRONIC STRUCTURE OF DIAMOND, SILICON AND GERMANIUM. G.G.Hall.
Phil. Mag. (Eighth Ser.), Vol. 3, 429-39 (May, 1958).

The equivalent orbital method of describing the electronic structure of valence crystals, introduced in an earlier discussion of diamond, is extended in various ways. The interactions of more distant bonds are now included so that a more detailed description of the electronic structure can be given. The role of the equations as interpolation formulae is illustrated and used to deduce the effective masses of holes for diamond, silicon and germanium. The application of the method to the conduction bands is also considered. A.

539.2 : 539.19

3461. EFFECT OF PRESSURE ON CN^- DISSOLVED IN AN ALKALI HALIDE LATTICE. T.E.Slykhouse and H.G.Drickamer.
J. chem. Phys., Vol. 27, No. 5, 1226-7 (Nov., 1957).

Describes experiments on the effect of high pressures (50000 atm) on the CN^- stretching frequency in a system consisting of up to 1% KCN in KCl. There are two CN^- bands, A at 2182 cm^{-1} and B at 2232 cm^{-1}. Band B only appears after compressing the material to form a pellet and grows with time; it is ascribed to CN^- at lattice imperfections, while band A represents CN^- replacing Cl^- in the normal lattice. J.Hawgood

539.2

3462. NUCLEAR SPIN RELAXATION IN HYDROGEN. III. THE SOLID NEAR THE MELTING POINT. M.Bloom.
Physica, Vol. 23, No. 8, 767-80 (Aug., 1957).

For Pt II, see Abstr. 8754 (1957). The longitudinal and the transverse relaxation times t_1 and t_2 were measured at 30 Mc/s using the pulse method for the proton magnetic resonances in solid H_2 and HD in the region near the melting point where appreciable self-diffusion takes place. The $\log t_2$ v. $1/T$ plots are linear for both solids over a wide range of temperatures, indicating that the coefficients of self diffusion may be written in the form $D_0\exp(-E_a/Rt)$. The values of E_a obtained for H_2 and HD are 380 ± 20 calorie/mole and 600 ± 40 calorie/mole respectively, while the approximate values obtained for D_0 are 10^{-3} cm^2/sec and 0.1 cm^2/sec respectively. t_1 in H_2 is caused by the effect of reorientations of the ortho-H_2 molecules, and is found to be roughly temperature independent at 0.22 second, in agreement with the theory of Moriya and Motizuki. In HD, t_1 is caused by the presence of a small amount of H_2 impurity. A quantitative interpretation of the effect of the H_2 impurity shows that the activation energy for diffusion of H_2 in HD is approximately the same as in H_2 and that $D_0 \cong 10^{-4}$ cm^2/sec. A.

539.2

3463. Cl^{35} PURE QUADRUPOLE RESONANCE STUDIES OF RELAXATION TIMES IN SOLID SOLUTIONS OF p-DICHLOROBENZENE. D.E.Woessner and H.S.Gutowsky.
J. chem. Phys., Vol. 27, No. 5, 1072-4 (Nov., 1957).

Transient methods were used to measure the Cl^{35} nuclear relaxation times at room temperature in solid solutions of p-dichlorobenzene and p-dibromobenzene. The spin–lattice relaxation time T_1 and the phase memory time T_2 were found to be virtually independent of sample composition. However, the inverse line width T_2^* decreases very sharply from 3.1×10^{-4} sec in pure p-dichlorobenzene to 0.15×10^{-4} sec in a sample with 20 mole% p-dibromobenzene. Thus, the main effect of the solute molecules is to broaden the absorption line by producing a distribution in the electric field gradients at the chlorine nuclei. Mechanisms for the T_1 and T_2 results are discussed. A.

539.2

3464. THE DECORATION OF DISLOCATIONS IN CRYSTALS OF SILVER CHLORIDE WITH GOLD. J.T.Bartlett and J.W.Mitchell.
Phil. Mag. (Eighth Ser.), Vol. 3, 334-41 (April, 1958).

A new method is described for the decoration of dislocations in crystals of silver chloride. The crystals are sensitized by heating them, together with gold wire and cupric chloride, in an atmosphere of chlorine in sealed tubes at a temperature of 350°C. They are then

strained, exposed to light with a wavelength which is not strongly absorbed by silver chloride, and heated for a few minutes at a temperature between 140 and 160°C. Nuclei which are formed along the dislocation lines during exposure increase to visible size during the subsequent thermal treatment. The formation of systems of prismatic dislocations around precipitates in silver chloride crystals is described and it is suggested that the observations may be relevant to the interpretation of precipitation hardening in certain alloys. A.

539.2

3465. DENSITY CHANGES OF CRYSTALS CONTAINING DISLOCATIONS. A.Seeger and P.Haasen.
Phil. Mag. (Eighth Ser.), Vol. 3, 470-5 (May, 1958).

Zener's theory of the volume expansion of self-strained elastic bodies is applied to screw and edge dislocations in isotropic media. The important physical parameters entering are the pressure dependence of the shear modulus, and, to a lesser extent, that of the bulk modulus. Numerical results for a number of materials are given. The volume expansion per atomic length of a dislocation line is found to be of the order of magnitude of one to two atomic volumes, thus confirming an earlier estimate by Stehle and Seeger (Abstr. 1476/1957). A.

539.2

3466. STUDIES OF COLOR CENTERS IN POLYCRYSTALLINE COMPRESSED PELLETS OF ALKALI HALIDES. H.N.Hersh.
J. chem. Phys., Vol. 27, No. 6, 1330-8 (Dec., 1957).

Compressed and uncompressed powders of several alkali halides (KCl, KBr, KI, CsI) were coloured by X-rays and by chemical addition and their spectra measured. The X-ray darkenability of pellets is greater than of single crystals, with respect to F, V_2, and V_3 bands. The F-centres are relatively unstable optically; their bleaching is rapid and complete and does not give rise to appreciable K, M, R and N bands, in constrast to F-centres in single crystals. After F irradiation the pellets still exhibit intense, well-resolved V_2 and V_3 bands and, upon dissolving in water, liberate free halogen. The relative intensity of the F and V bands may be controlled by varying the X-ray of F-light exposure. KI pellets may be additively coloured at room temperature with iodine. In general V bands may be produced by adsorbing halogen onto the crystalline surface and are more stable in the compressed pellets than the unconfined powder. By virtue of their different physical makeup from a single crystal the pellets exhibit the above colour-centre phenomena to a larger degree than single crystals. A.

539.2 : 535.377

COLORATION OF LITHIUM FLUORIDE PRODUCED BY ALPHA PARTICLES, ELECTRONS, GAMMA RAYS, AND NEUTRONS. See Abstr. 2991

539.2

3467. THE EFFECTS OF PENETRATING RADIATIONS ON MATERIALS. S.F.Pugh.
Brit. J appl. Phys., Suppl. No. 6 (Physics of non-destructive testing), S36-S39 (1957).

An elementary account is given of the changes produced in solids by irradiating them with fast particles. One aspect of this work is the investigation of the properties of various types of lattice defect produced by irradiation. An advance in understanding this subject will also help in the further development of non-destructive testing techniques. A.

539.21

3468. STUDY OF THE ACTION OF IONIZING RADIATION ON QUARTZ BY MEANS OF ELECTRON PARAMAGNETIC RESONANCE. Yu.N.Molin and V.V.Voevodskiĭ.
Zh. tekh. Fiz., Vol. 28, No. 1, 143-9 (1958). In Russian.

Paramagnetic resonance absorption in fused quartz irradiated with γ-rays, and in crystalline quartz irradiated with γ-rays and neutrons was measured. In fused quartz two types of paramagnetic absorption centres were found. Increase of the number of these centres with increase of the radiation dose and their behaviour on heating were studied. The authors suggest that these centres are formed by holes and electrons captured by structural defects (traps). See also Abstr. 2807 (1957).

539.21 : 536.424.1 : 534.222.2

MULTIPLE SHOCK PRODUCTION. See Abstr. 2901

STRUCTURE OF SOLIDS

539.211

3469. STRESS RUPTURE IN GLASS. H.A.Elliott.
J. appl. Phys., Vol. 29, No. 2, 224-5 (Feb., 1958).

The fracture of glass at low stresses when exposed to the atmosphere for long periods may be due to diffusion of corrosion agents to the bottom of incipient cracks. If it might be assumed that the corrosive agent diffuses through the amorphous, fissured, corrosion product of negligible strength which remains in the crack, the theory of growth of oxide films may be used to derive the following relation between the applied stress F and the time to fracture t:

$$1/F^2 = A_0 \log t + B_0,$$

where A_0 and B_0 are constants. Good agreement was found between theoretical values derived from this formula and experimental points. A.C.Whiffin

539.211 : 539.42

3470. EFFECT OF ORIGIN FLAW CHARACTERISTICS ON GLASS STRENGTH. W.C.Levengood.
J. appl. Phys., Vol. 29, No. 5, 820-6 (May, 1958).

Glass breakage experiments were made which indicate two different mechanisms of fracture. The breaking process is dependent on the widths as well as the depth of the origin flaws. When the fracture is of the large, open type, the reciprocal of the breaking stress is a linear function of the depth of flaw; when the flaw is minute, the reciprocal of the breaking stress is a linear function of the square root of fracture depth. A pronounced strength increase was observed in cuts formed under various liquids and aged for various lengths of time. This increase took place about one hour after cutting and was interpreted as a rehealing phenomenon. Cuts made in air did not show the rapid strength increase. Cycle fatigue tests were also made on laths of glass and it was observed that there was an initial decrease in strength followed by an increase. This was interpreted as rehealing effect in the minute type of flaw. A.

539.213

3471. NONCRYSTAL IONIC MODEL FOR SILICA GLASS. L.W.Tilton.
J. Res. Nat. Bur. Stand., Vol. 59, No. 2, 139-54 (Aug., 1957).

The proposed model consists of five-sided rings of tetrahedra so connected that all five silicons lie in one plane and all angles Si—O—Si are about 180°. These rings combine to form dodecahedral cages, which can be fitted together only by introducing considerable strains. The name "vitron" is proposed for a cluster of these dodecahedra. It is claimed that this model accounts for the low thermal expansion, the radial distribution of atoms, the strength, and the property of allowing gaseous diffusion. A.R.Stokes

539.213.1

3472. ATOMIC CHAIN AND LAYER STRUCTURE OF GLASS. V.V.Tarasov.
Kristallografiya, Vol. 2, No. 4, 489-96 (1957). In Russian.

The change in heat capacity with temperature of simple glasses and glass-forming substances is considered in relation to their structure. Special attention is paid to B_2O_3, Nb_2O_5 and $NaPO_3$. R.F.S.Hearmon

539.213.22 : 535.32

CRITICAL STUDY OF THE OPTICAL AND MECHANICAL PROPERTIES OF GLASS FIBRES. See Abstr. 2939

539.213.22 : 536.4

COOLING TIME OF STRONG GLASS FIBRES. See Abstr. 3028

539.216

3473. THE STRUCTURE OF FIBROUS SULFUR. J.A.Prins, J.Schenk and L.H.J.Wachters.
Physica, Vol. 23, No. 8, 746-52 (Aug., 1957).

It is shown that plastic sulphur, at least in the extended state of fibrous φ-sulphur, is made up from two constituents in roughly equal portions, one fibrous and one with smaller molecules. The last constituent is found to be the γ-sulphur of Muthmann. The recrystallization of both constituents to α is studied. It is found that γ recrystallizes to α', a name here given to α-needles along the [101] direction. A.

539.217

3474. AN ELECTRICAL ANALOGUE METHOD OF PREDICTING THE PERMEABILITY OF UNSATURATED POROUS MATERIALS. M.C.Probine.
Brit. J. appl. Phys., Vol. 9, No. 4, 144-8 (April, 1958).

The manner in which the permeability of unsaturated porous materials varies with moisture content was investigated, using an electrical analogue technique. The hydraulic resistance of a water channel in the porous material was represented by an electrical resistor, and the three dimensional network of channels by a corresponding three dimensional resistance network. With all the resistors in circuit the electrical resistance across opposite faces of the network is assumed to be inversely proportional to the saturated permeability. Empty channels are not effective in transporting liquid so that drying of the material is simulated by progressively removing resistors representing the largest of the remaining water-filled channels. In this way the decreasing permeability of the material as it dries out can be related to its moisture content. The predictions by the analogue method agree very well with the experimentally determined values. A.

539.217 : 537.583

3475. THE USE OF POSITIVE-ION EMISSION FOR THE DETERMINATION OF DIFFUSION CONSTANTS IN SOLID BODIES. I.Cornides.
Naturwissenschaften, Vol. 45, No. 6, 125-6 (1958). In German.

The positive-ion emission from hot bodies, due to excape of low-work-junction surface atoms (for evaporation as an ion, the ionization potential must be less than the work junction of the surface from which the ion excapes) shows a time variation, at a given temperature. This is due to diffusion from the interior of the emitter and so provides a basis for the measurement of diffusion coefficients of, for example, potassium in molybdenum. A brief description of experiments and results is given. J.D.Craggs

539.217

3476. THE INFLUENCE OF PRESSURE ON THE MEAN TIME OF STAY OF INTERSTITIAL NITROGEN IN IRON.
A.J.Bosman, P.E.Brommer and G.W.Rathenau.
Physica, Vol. 23, No. 11, 1001-6 (Nov., 1957).

Measurements of the time decrease of initial permeability can reveal small relative changes of the mean time of stay of interstitial atoms at the position of equilibrium. Application of a hydrostatic pressure of 3000 kg/cm^2 does not lead to changes exceeding 1%. It is concluded that the activation volume for interstitial nitrogen diffusion in b.c.c. iron is: $(3.7 \pm 3.3)\ 10^{-2}$ cm^3/mole. This corresponds to about 4% of the volume of the diffusing nitrogen atoms. A.

539.217

3477. DIFFUSION OF NEGATIVE ION VACANCIES IN POTASSIUM CHLORIDE. J.Ewles and S.C.Jain.
Proc. Roy. Soc. A, Vol. 243, 353-8 (Jan. 14, 1958).

The results of experimental investigations on the rate of relaxation of the enhanced electrical conductivity produced by rapid quenching of potassium chloride are shown to be in good agreement with the theoretical findings of Jain (see the following abstract) for the rate of annihilation of lattice vacancies by diffusion to surfaces. The rate of relaxation is found to be independent of the size and shape of specimen, suggesting that the surfaces at which annihilation occurs are those of a submicroscopic structure. The temperature and time dependence of the relaxation together with the theory permit the evaluation of the diffusion coefficient for negative ion vacancies ($D_0 \sim 7$ cm^2/sec) for potassium chloride, their energy of migration (1.86 eV) and the order of the dimensions of the mosaic blocks (10^{-5} cm). A.

539.217 : 536.21

3478. SIMPLE SOLUTIONS OF THE PARTIAL DIFFERENTIAL EQUATION FOR DIFFUSION (OR HEAT CONDUCTION). S.C.Jain.
Proc. Roy. Soc. A, Vol. 243, 359-74 (Jan. 14, 1958).

It is shown that simple approximate solutions of the partial differential equation for diffusion (or heat conduction) in finite solids of various shapes and under various conditions can be derived from the simple solutions which are rigorously applicable to linear diffusion in a semi-infinite slab. The case in which the initial volume concentration is constant and the surface concentration is zero is considered in detail. For linear diffusion in a finite slab, the solutions show that each end of the slab can be regarded as functioning as the end of a semi-infinite slab for a time during which the central and the average fractional concentrations fall to 0.6 and 0.3, respectively. For a small region near the centre, this is true for a much longer time range, i.e. till the central and the average fractional concentrations fall to 0.2 and 0.1, respectively. Hence, very simple expressions for the concentration distribution or for average concentration in solids of various shapes are obtained without using any special mathematical method. The condition under which a solid of any shape or dimensions behaves as a linear semi-infinite slab is formulated. Some empirical and experimental findings of other workers are examined and found to be consistent with the theoretical conclusions. To illustrate the general applicability of the method, linear diffusion in a finite slab when the material is generated inside it at a constant rate or when the surface concentration increases linearly with time is briefly discussed and explicit results given. All expressions are obtained in terms of a dimensionless parameter, and it is shown that the concentration distribution in solids of any material and of various shapes can be derived from one single universal curve. Tables and graphs are given showing the relation between the numerical values calculated from the present simple solutions and those obtained by other much more laborious methods. A.

539.217

3479. ON DIFFUSION OF COPPER IN SILICON [AT 800-1100°C]. B.I.Boltaks and I.I.Sozinov.
Zh. tekh. Fiz., Vol. 28, No. 3, 679 (1958). In Russian.

539.219

3480. A SIMPLE TREATMENT OF ORDERING KINETICS. A.S.Nowick and L.R.Weisberg.
Acta metallurgica, Vol. 6, No. 4, 260-5 (April, 1958).

The differential equation for the kinetics of ordering, derived by Dienes (1955) from chemical rate theory, is simplified, by making suitable approximations, into a second-order differential equation whose solutions are hyperbolic functions. It is shown that these functions adequately describe the data for changes in long-range order of Cu_3Au. It is further shown that the rate constant, α, which appears in these equations is given to a good approximation by an Arrhenius-type equation in which the frequency factor and activation energy have simple interpretations. A.

539.219

3481. ORDERING KINETICS IN LONG-RANGE ORDERED Cu_3Au. R.Feder, M.Mooney and A.S.Nowick.
Acta metallurgica, Vol. 6, No. 4, 266-77 (April, 1958).

The kinetics of the change of order in a partly long-range ordered Cu_3Au alloy, when the temperature is varied below the critical temperature, are studied in the range 210°-290°C by means of precision lattice-parameter measurements. These data, and the results of Weisberg and Quimby for the range of temperature above 290°C, are analysed in terms of the second-order kinetic equations predicted from the theory presented in a previous paper (see preceding abstract). The results show that the theory is obeyed remarkably well, in particular that the rate constant, α, which appears in the kinetic equations, varies exponentially with the reciprocal absolute temperature up to 320°C. The plot of log α v. T^{-1} gives an activation energy of 2.03 eV and a frequency factor of 3.6×10^{14} sec^{-1}. In addition, the variation of ordering energy with the long-range order parameter is estimated. It is found that the energy to produce a wrong Cu–Au pair in the otherwise perfect alloy is in the vicinity of 0.4-0.5 eV. This value is in good agreement with that obtained from calorimetric measurements, when the latter are corrected for the residual short-range order present above the critical temperature. A.

539.219 : 548.73

3482. LATTICE PARAMETER AND SHORT-RANGE ORDER. G.J.Dienes.
Acta metallurgica, Vol. 6, No. 4, 278-82 (April, 1958).

A relation has been derived between the nearest-neighbour distance, r, the composition, x, and the short-range order parameter, σ, for binary alloys based on nearest-neighbour interactions, additivity of bond energies and quadratic expansion of energy as a function of distance. The relation is shown to be applicable to random alloys of copper and gold and silver and gold. The relation describes the dependence of r on short-range order and the theoretical predictions are compared to experiments on Cu_3Au. For this alloy the right direction and about the right magnitude of Δr are predicted upon ordering. The relation between r and σ is, in general, nonlinear, but a linear approximation is quite satisfactory for Cu_3Au. A.

539.219

3483. THE THEORY OF ORDERING IN ALLOYS. I.L.Aptekar'.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 1, 122-5 (1957). In Russian.

The relation between long and short-range order is discussed and the general conclusion reached that it is essentially impossible to describe the development of long-range order by unmodified nearest-neighbour interactions only. S.F.Edwards

539.219

3484. THE MUTUAL RELATIONSHIP BETWEEN THE PROCESSES OF DIFFUSION AND REBUILDING OF THE LATTICE IN THE DECAY OF SUPERSATURATED SOLID SOLUTIONS IN ALLOYS. Yu.A.Bagaryatskiĭ and Yu.D.Tyapkin.
Dokl. Akad. Nauk SSSR, Vol. 115, No. 6, 1111-14 (1957). In Russian.

Dimensions of the unit cells of the γ solid solution in aged Ni–Cr–Ti alloys were found for the regions rich in Ti(γ_1), for those with average composition (γ_0) and for those poor in Ti(γ_2). Quenched from 1250° C the dimensions (γ_1,γ_0 and γ_2) were 3.586 ± 0.005, 3.569 ± 0.001 and 3.564 ± 0.005 A. After annealing at 800° C for 2 hours the dimensions were 3.587 ± 0.003 A for γ_1, and 3.564 ± ± 0.005 A for γ_2. After annealing at 850° C for 2 hours γ_1 and γ_2 were 3.591 ± 0.005 A and 3.564 ± 0.005 A, having atomic volumes of 11.58 and 11.32 respectively. After slow cooling from 1200° C the γ_1 phase was hexagonal with an atomic volume of 11.52, while the γ_2 phase had a cell dimension of 3.560 ± 0.002 A.

A.L.Mackay

539.219 : 532.78

3485. STRUCTURAL PECULIARITIES OF LIQUID ALLOYS IN SOME BINARY SYSTEMS. D.K.Belashchenko.
Dokl. Akad. Nauk SSSR, Vol. 117, No. 1, 98-101 (1957). In Russian.

The "structure-sensitive" properties chosen were viscosity and electric resistance. The method used involved measurement of kinematic viscosity through the decrement of torsional oscillations of a cylindrical crucible with the liquid, suspended by an elastic thread, and the simultaneous measurement of electric conductivity through the torsional angle of the specimen in a rotating magnetic field (Regel', Abstr. 4793/1949). The binary systems tested were Sb–Sn, Cd–Sb, Cd–Cu, Pb–Tl, Bi–Tl and Fe–Ni, all experiments being carried out in an atmosphere of hydrogen. Hysteresis on heating and cooling was found in many of these alloys, and a change in time (relaxation) in the case of Bi–Tl over a certain temperature range where the viscosity/temperature curve forms a loop. The results are shown in graphs. F.Lachman

539.219 : 537.311.33

3486. SOME PROPERTIES OF GALLIUM ARSENIDE–GERMANIUM MIXTURES. D.A.Jenny and R.Braunstein.
J. appl. Phys., Vol. 29, No. 3, 596-7 (March, 1958).

The solubility of Ge in GaAs is probably less than two atomic per cent, in spite of the near identity of their cubic lattice parameters. Optical transmission measurements indicated that Ge reduces the 1.35 eV band gap of GaAs by a maximum of 0.1 eV. Hall measurements suggested that Ge acts as a donor in GaAs with a very small doping efficiency. B.T.M.Willis

539.219

3487. CRITICAL OPALESCENCE IN SOLID SOLUTIONS. A.Münster and K.Sagel.
Molecular Phys., Vol. 1, No. 1, 23-43 (Jan., 1958). In German.

By measuring the intensity of diffuse X-ray scattering of the system Al–Zn it is shown for the first time that solid solutions exhibit the phenomenon of critical opalescence as well as liquid solutions and condensing gases. An outline is given of the theoretical background, the experimental technique and the method of evaluation. The correlation functions are calculated from the experimental scattering curves. An estimate is made of the correlation range for the critical composition. About 0.5deg C above the critical temperature a value of 31 A has been found. A.

539.219

3488. QUENCHING VACANCIES IN DILUTE BINARY PLATINUM SOLID SOLUTIONS. S.Pearson and F.J.Bradshaw.
Phil. Mag. (Eighth Ser.), Vol. 2, 1387-8 (Nov., 1957).

The measurements of Abstr. 2821 (1957) were repeated for Pt wires containing (a) 1 atomic % of Rh and (b) 1/2 atomic % of Au. It is deduced that the vacancy–solute atom binding energies are small compared with the vacancy formation energy. D.M.Edwards

539.219 : 539.371

3489. DIRECT OBSERVATION OF THE STRAIN FIELD PRODUCED BY COHERENT PRECIPITATED PARTICLES IN AN AGE-HARDENED ALLOY. R.B.Nicholson and J.Nutting.
Phil. Mag. (Eighth Ser.), Vol. 3, 531-5 (May, 1958).

Transmission electron micrographs of aged aluminium/4%-copper foils have shown unusual contrast near precipitated particles. This is interpreted in terms of Bragg diffraction from regions distorted by elastic coherency strains between the precipitate and the matrix. A.

539.219 : 539.18

STATES OF ATOMS IN ALLOYS OF THE TRANSITION ELEMENTS. See Abstr. 3397

539.23 : 539.27

3490. FORMATION OF OXIDES IN LEAD SULPHIDE LAYERS AND PHOTORESISTORS.
V.N.Vertsner, N.A.Kel'ner and A.M.Solov'ev.
Kristallografiya, Vol. 2, No. 4, 497-502 (1957). In Russian.

Lead sulphide films were deposited on glass, and the change in composition of the film when heated in air was investigated by an electron diffraction method. R.F.S.Hearmon

539.231

3491. DEPOSIT SPOT PATTERNS FROM LOW-INDEX PLANES OF METAL SINGLE CRYSTALS IN A NEW THEORY OF CATHODE SPUTTERING. E.B.Henschke.
J. appl. Phys., Vol. 28, No. 4, 411-20 (April, 1957).

The generation of the deposit spot patterns from low-index planes at lower and higher ion energy is explained by mechanical double and triple collisions of the perpendicular incident ions with lower and upper surface atoms of the target plane. The effective collision spheres are assumed to be determined by the largest closed electronic shells of the ion and the target atom with radii smaller than the radii of the largest electronic orbits of these shells. A second factor has to be taken into account for the explanation of the shape and other features of the single spots of the patterns. This is the attenuating influence of the different electron densities in the paths of the ion within the lattice, because the largest closed electronic shells exceed the size of the collision spheres and produce the highest electron density in close-packed rows of the lattice. These two concepts are sufficient to explain the number and arrangements of the spots in the patterns of low-index planes; the specific shape of the single spots; the alterations of the spot patterns connected with higher ion energy or with accidental deviations of the prepared crystal plane from the ideal crystallographic plane; the deviation of the symmetry axis of the single spots in (110) f.c.c. patterns from the diagonal direction of the unit area; and the different shape and size of the single spots in (111) spot patterns of Ag and Cu. A.

539.234

3492. ON THE PHYSICO-CHEMICAL PROPERTIES OF THIN FILMS OF THE MAGNESIUM–BISMUTH AND MAGNESIUM–ANTIMONY COMPOUNDS. G.A.Kurov.
Zh. tekh. Fiz., Vol. 27, No. 11, 2664-5 (1957). In Russian.

The results of the present author's earlier investigations reported elsewhere led to him to believe that the Mg_3Sb_2, Mg_3Bi_2 and Mg_2Sn intermetallic compounds present in thin films formed by evaporation are unstable and are easily decomposed by atmospheric O to MgO and metallic Sb, Bi and Sn. Evidence is brought in to support this view, the correctness of which has been questioned by other investigators. M.H.Sloboda

539.234

3493. ELECTRON DIFFRACTION INVESTIGATION OF InSb FILMS. S.A.Semiletov and M.Rozsival.
Kristallografiya, Vol. 2, No. 2, 287-8 (1957). In Russian.

InSb films were produced by vacuum deposition on celluloid or NaCl. Electron diffraction experiments showed the presence of cubic and hexagonal modifications in all films whatever the method of preparation. R.F.S.Hearmon

539.234 : 535.39

OPTICAL PROPERTIES AND STRUCTURE OF CERIUM DIOXIDE FILMS. See Abstr. 2995

539.26 : 548.734

3494. THE POTENTIALITIES OF X-RAY DIFFRACTION STUDIES IN NON-DESTRUCTIVE TESTING.
J.R.Rait and H.S.Peiser.
Brit. J. appl. Phys., Suppl. No. 6 (Physics of non-destructive testing), S13-S17 (1957).

The concept of a non-destructive test is defined. One of the criteria — that the purpose of examination be to relate past history of a particular specimen (or group of specimens) with expected future service performance — is not fulfilled by much conventional X-ray diffraction work. Nevertheless, five groups of X-ray diffraction test are useful in non-destructive examinations:

(i) X-ray fluorescent spectrometry in chemical element analysis; (ii) X-ray diffratometric phase analysis; (iii) X-ray measurements of orientation textures; (iv) precision X-ray determinations of lattice parameters, which depend on solid-solution, temperature and strain effects; (v) X-ray determinations of line profiles related to crystal size and perfection. Conventional X-ray diffraction tests suffer from (a) insensitivity to localized, but physically significant lattice defects, and (b) restrictions due to the smallness of surface volumes examined. The latter short-coming is overcome by high-voltage diffraction testing which, however, is limited to coarsely-grained materials. For these it provides a non-destructive grain-size test. Polychromatic streaks (asterism) on high-voltage diffraction pictures are interpreted in terms of small changes of lattice orientation within grains due to strains or polygonization. Absence of streaks implies a high degree of grain perfection which is lost under diverse types of service conditions such as those causing fatigue in metals. A.

539.27

3495. A TECHNIQUE FOR OBTAINING THIN FOILS OF ALUMINIUM AND ALUMINIUM ALLOYS FOR TRANSMISSION ELECTRON METALLOGRAPHY.
R.B.Nicholson, G.Thomas and J.Nutting.
Brit. J. appl. Phys., Vol. 9, No. 1, 25-7 (Jan., 1958).

The structural changes produced by ageing Al–Cu and Al–Mg–Zn–Cu alloys were investigated by examining foils of these alloys in the electron microscope. The foils were obtained by mechanical reduction in thickness followed by controlled electro-polishing and chemical dissolution of the remaining oxide film. A.

539.27

3496. AN IMPROVED SPRAY DROPLET TECHNIQUE FOR QUANTITATIVE ELECTRON MICROSCOPY.
H.L.Nixon and H.L.Fisher.
Brit. J. appl. Phys., Vol. 9, No. 2, 68-70 (Feb., 1958).

Improvements are described to the spray droplet method of Backus and Williams for direct particle counting by electron microscopy. Decreasing the droplet size makes it possible to use much higher magnifications without sacrificing the ability to photograph each droplet trace entire on one frame, and droplets of the desired size are sorted and collected in a reproducible manner in a cascade impactor. The technique is also useful for studying the state of aggregation of a suspension. Some factors affecting the accuracy of measurement of the polystyrene latex standard particles are discussed. Different methods yield different values, and there is at present no valid basis for selecting the best estimate. A.

539.27

3497. ELECTRON MICROSCOPE INVESTIGATION OF OBJECTS IN A GASEOUS MEDIUM. I.G.Stoyanova.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 2, 325-7 (1958). In Russian.

Previous work on the examination of objects in the electron microscope has been limited to comparatively low pressures. The present paper describes an arrangement in which the electron path through the gas is kept to a minimum so that the specimen can be practically at atmospheric pressure and still be resolved at 120 angstroms. T.Mulvey

539.27

3498. EXPERIMENTAL STUDY OF ELECTRON SCATTERING IN ELECTRON MICROSCOPE SPECIMENS. C.E.Hall and T.Inoue.
J. appl. Phys., Vol. 28, No. 11, 1346-8 (Nov., 1957).

Effective scattering cross-sections for polystyrene in electron microscope specimens were measured through the microdensitometry of the images of polystyrene latex spheres, recorded with an RCA Type EMU 3B electron microscope. Measurements were made at both 50 and 100 kV beam potential without an objective aperture, with a 40 μ aperture and with a 20 μ aperture. Cross-sections per gramme vary from 1.9 to 11×10^4 cm^2/g. The results are consistent with previous experimental data and are in reasonable agreement with theoretical calculations. A.

539.27

3499. METHOD FOR MAKING SUCCESSIVE REPLICAS OF THE SAME SPOT. J.T.Fourie.
J. appl. Phys., Vol. 29, No. 4, 608-10 (April, 1958).

A technique is described in which use is made of the slit type electron microscope specimen carrier for replicating successively the same spot on a metal sample. The main advantage is that no specialized apparatus is required. By using the slit type specimen carrier a relatively large undisturbed field of view is obtained. A series of electron micrographs showing the formation and growth of slip lines on an α-brass single crystal is used to demonstrate the capabilities of the method. A.

539.27

3500. SIMULTANEOUS EVAPORATION OF PLATINUM AND CARBON FOR POSSIBLE USE IN HIGH-RESOLUTION SHADOW-CASTING FOR THE ELECTRON MICROSCOPE. D.E.Bradley.
Nature (London), Vol. 181, 875-7 (March 29, 1958).

Conventional methods for shadowing electron microscope specimens to increase the contrast suffer from a lack of resolution caused by aggregation of the shadowing material. This can be prevented by the simultaneous evaporation of carbon and a heavy metal such as platinum. A technique for doing this is described and micrographs are shown illustrating the improvement that is possible. T.Mulvey

539.27

3501. ELECTRON DIFFRACTION INVESTIGATION OF AMORPHOUS ANTIMONY SULPHIDE. L.I.Tatarinova.
Kristallografiya, Vol. 2, No. 2, 260-7 (1957). In Russian.

The interatomic distances in Sb_2S_3 are estimated from the radial distribution curves. There are approximately 6 atoms of S round each Sb atom, and approximately 4 atoms of Sb round each S atom. This suggests that the atoms arrange themselves in close packing. R.F.S.Hearmon

539.27

3502. ELECTRON DIFFRACTION INVESTIGATION OF NITRIDES AND CARBIDES OF TRANSITIONAL METALS.
Z.G.Pinsker and S.V.Kaverin.
Kristallografiya, Vol. 2, No. 3, 386-92 (1957). In Russian.

Results are given and photographs reproduced of the scattering of electrons by films of the nitrides of Fe, Cr, Mo, W, and of the carbides of Fe. R.F.S.Hearmon

539.27 : 537.533.35 : 621.385.833

REFLECTION ELECTRON MICROSCOPY AT HIGH ANGLES. See Abstr. 3184

539.27 : 537.311.33 : 621.382

APPLICATION OF THE ELECTRON SHADOW MICROSCOPE TECHNIQUE TO THE STUDY OF P–N JUNCTIONS. See Abstr. 3124

ELASTICITY. STRENGTH. RHEOLOGY

539.31

3503. THE INFLUENCE OF VACANCIES UPON THE INTERNAL FRICTION OF POLYCRYSTALLINE COPPER.
R.S.Barnes, N.H.Hancock and E.C.H.Silk.
Phil. Mag. (Eighth Ser.), Vol. 3, 519-26 (May, 1958).

Neutron irradiation, gamma irradiation and quenching all change the internal friction of pure polycrystalline rods of copper. Only if the rods are initially given an anneal near the melting point for many hours do these three treatments give consistent and similar results, and then the logarithmic decrement is reduced. It is concluded from the results that it is the vacancies introduced by each of the three treatments which pin the dislocation lines by diffusing to them, and that unless the purity of the copper is high their effect can be obscured. A.

539.31 : 539.21

3504. THE EFFECTS OF NEUTRON IRRADIATION UPON THE INTERNAL FRICTION OF COPPER SINGLE CRYSTALS AT LIQUID NITROGEN TEMPERATURES. R.S.Barnes and N.H.Hancock.
Phil. Mag. (Eighth Ser.), Vol. 3, 527-30 (May, 1958).

The internal friction of copper single crystals remains unaffected by a short neutron bombardment at -195°C if no warning is allowed before measurement. Successive pulse anneals produce no marked change until 23°C is reached, when the internal friction is greatly reduced. A.

539.32 : 539.53

3505. SOME ASPECTS OF THE MECHANICAL TESTING OF NON-METALLIC SOLIDS. H.Kolsky.
Brit. J. appl. Phys., Suppl. No. 6 (Physics of non-destructive testing), S1-S4 (1957).

Some problems associated with the mechanical testing of several classes of non-metals are reviewed. The difficulties encountered in measuring the elastic properties of rubbers, plastics and fibrous materials are considered and tests on the mechanical

strength of glass-like materials are discussed. The significance of static and dynamic hardness measurements on non-metals is then considered in detail and the way in which such quantities as rebound hardness may depend on the conditions of test rather than on the properties of the material being investigated is described. A.

539.32 : 534.321.9

3506. MEASUREMENT OF ELASTIC CONSTANTS BY THE ULTRASONIC PULSE METHOD. M.F.Markham.
Brit. J. appl. Phys., Suppl. No. 6 (Physics of non-destructive testing), S56-S63 (1957).

Definitions of stress and strain are given in terms of force and differential coefficients of displacement respectively, and the generalized form of Hooke's law is stated. This defines the elastic constants of a general aeolotropic medium. Special cases of cubic and hexagonal symmetry are considered. The elastic wave equations are derived for plane waves in an infinite aeolotropic solid. The velocities of the three types of wave are given for certain directions in cubic and hexagonal materials. Difficulties may be encountered in propagation of waves along axes other than principal ones due to the oblique path along which the energy travels. This may limit the use of the method to certain directions depending upon the geometry of the specimen. A brief outline of the apparatus used is given, and the accuracy which may be achieved is discussed. The method may be applied to polycrystalline materials provided that the grain size is reasonably small. A.

539.32

3507. MEASUREMENT OF ELASTICITY AND ANELASTICITY OF SMALL DISKS BY AN INDUCTOR METHOD.
G.Bradfield and F.A.Levi.
Brit. J. appl. Phys., Vol. 9, No. 1, 13-16 (Jan., 1958).

An instrument is described, operating on the inductor principle, to set a small disk into radial vibration so that one of its elastic constants can be determined from its frequencies of resonance. The method of testing also permits the internal friction to be measured as the ratio Q_m of the real to the imaginary component of the elastic compliance. The accuracy of determination of the resonance frequency is to better than 1 part in 50 000, and the determination of the internal friction ratio to better than 1 part in 50 in a typical case when, for example, Q_m is about 3000. The elastic constant directly derived is the "sheet" modulus $E/(1 - \sigma^2)$, where σ is Poisson's ratio and E is Young's modulus. A.

539.32

3508. THE ELASTICITY OF RUBBER. L.A.Wood.
J. Washington Acad. Sci., Vol. 47, No. 9, 281-99 (Sept., 1957).

This is a review of the present state of knowledge of the elasticity of rubber. The stress-strain curves for extension and compression of most of the simple vulcanized natural rubbers and of the three most important synthetic rubbers are similar in shape, being expressed in the form $F/M = (L^{-1} - L^{-2})\exp A(L - L^{-1})$, where F is the stress, L the ratio of stretched to unstretched length, and M and A are constants. Stress-temperature relations indicate that the tendency of long chain flexible molecules to return to a configuration that is statistically more probable than the one which the stretching has forced them to assume is the most important factor in the retraction of stretched rubber. A strain-energy function deduced from entropy changes arising from stretching is discussed, and the corresponding stresses agree with those in compression, but are greater than those observed in extension by about 50% at L = 3. One of the most important current problems in rubber elasticity is the explanation, in molecular terms, of the strain-energy relations in the range L = 1.5 to L = 3. H.J.H.Starks

539.32 : 536.424

3509. CHANGE IN THE ELASTIC CONSTANTS OF SODIUM NITRATE IN A SECOND-ORDER PHASE TRANSFORMATION.
M.I.Kornfel'd and A.A.Chudinov.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 33-6 (1957). In Russian.

The temperature dependence of the elastic constants of $NaNO_3$ crystal was investigated in a temperature interval from 20 to 300°C. The change of these constants at 275.5°C, a phase transition point of the second order, was studied. See also the following abstract. A.

536.424 : 539.32

A SECOND-ORDER PHASE TRANSFORMATION IN SODIUM NITRATE. See Abstr. 3509-10

539.32 : 536.424

3510. SECOND-ORDER PHASE TRANSFORMATION IN SODIUM NITRATE. I.E.Dzyaloshinskii and E.M.Lifshits.
Zh. éksper. teor. Fiz., Vol. 33, No. 1(7), 299-301 (1957). In Russian.

The changes in the elastic constants of sodium nitrate at the second-order transformation point are calculated to be $\Delta s_{11} = \Delta s_{12} \leq 0.01\ \Delta s_{33}$, $\Delta s_{13} \leq 0.1\ \Delta s_{33}$ in good agreement with the experimental values found by Kornfel'd and Chudinov (see the preceding abstract). R.C.Murray

539.32.07

3511. AN APPARATUS FOR THE DETERMINATION OF DYNAMIC ELASTIC MODULI AT LOW STRAINS.
E.V.Vernon.
J. sci. Instrum., Vol. 35, No. 1, 28-9 (Jan., 1958).

An electronic apparatus is described for the determination by a resonance method of Young's modulus and the modulus of rigidity of materials in the form of cylindrical rods. Results can be obtained at strains as low as 10^{-9}. The method of calculation of the moduli from the observed resonant frequencies is given. A.

539.373 : 548.0

3512. INVESTIGATION OF SLIP LINES IN SILVER CHLORIDE CRYSTALS. V.E.Kochnov and M.P.Shaskol'skaya.
Kristallografiya, Vol. 2, No. 2, 274-7 (1957). In Russian.

Some of the slip lines in plastically deformed AgCl form steps on the surface of the crystal which may be up to 3×10^3 A in height. Undulating slip lines occur as a result of fusion of rectilinear slip lines which appear in the initial stages of plastic deformation. The plastic deformation process in AgCl is similar to that in metals. R.F.S.Hearmon

539.373 : 539.431

3513. ANNEALING IN SLIP BANDS IN COPPER FATIGUED AT 90°K. D.Hull.
Phil. Mag. (Eighth Ser.), Vol. 3, 513-18 (May, 1958).

The number of slip bands formed during the fatigue of oxygen-free high-conductivity copper at 90°K and 293°K have been compared. For equivalent stresses to cause failure in 2×10^6 cycles, more slip bands are formed at 90°K than at 293°K. The number of slip bands formed increases with the length of the test. When specimens are fatigued at 90°K, and heated to room temperature at intermediate stages, the rate of increase of slip bands is much smaller than for specimens kept entirely at 90°K. The intermediate heating effectively makes the slip bands softer than the surrounding regions so that on further fatiguing slip is localized near or within the slip band. The critical temperature for the intermediate heating, above which the annealing occurs, is approximately 180°K. The results are attributed to point defect hardening during the annealing treatment. A.

539.374

3514. DISCONTINUITY IN THE FLOW CURVE OF POLYETHYLENE. E.B.Bagley, I.M.Cabott and D.C.West.
J. appl. Phys., Vol. 29, No. 1, 109-10 (Jan., 1958).

Two distinct output v. pressure curves are obtained, corresponding to smooth and irregular extruded filaments of a molten polymer from a capillary. The output is considerably larger when the filament is rough and distorted. Rough filaments are generally obtained at higher pressures than smooth filaments, but there is an intermediate range of pressure where either type of extrusion can be obtained. J.G.Oldroyd

539.374

3515. HETEROGENEITIES OF STRESS DISTRIBUTION IN POLYCRYSTALLINE GRAINS IN THE INITIAL STAGES OF THE PROCESS OF PLASTIC DEFORMATION. V.E.Kochnov.
Kristallografiya, Vol. 2, No. 2, 303-4 (1957). In Russian.

Observations were made of the formation of bands of double refraction in polycrystalline AgCl at stresses up to 100 g/mm² and are interpreted in terms of irregularities in the stress distribution in the grains. R.F.S.Hearmon

539.374

3516. PLASTICITY OF CLAY–WATER SYSTEMS.
A.K.Chatterji.
Nature (London), Vol. 181, 1118-19 (April 19, 1958).

The plastic deformation of very soft "ice" crystals, formed on the surfaces of the clay particles in clay–water systems of different concentrations, is put forward as a possible explanation of the plastic behaviour of these systems. J.G.Oldroyd

539.374

3517. PLASTIC DEFORMATION OF NICKEL SINGLE CRYSTALS AT LOW TEMPERATURES. P.Haasen.
Phil. Mag. (Eighth Ser.), Vol. 3, 384-418 (April, 1958).

Single crystals of nickel (purities 99.98% and 99.4%) have been deformed in tension at various temperatures between 4.2°K and 300°K. Shear stress–strain relations have been determined as well as the reversible change of flow stress with temperature. The work-hardening parameters obtained are discussed in terms of dislocation theory that has been developed mainly on the basis of data on Al and Cu. From the temperature dependence of the stress at the beginning of dynamical recovery the activation energy of cross-slip is estimated to be slightly lower than that of copper, implying a somewhat higher stacking fault energy. The advantages of the temperature change method for an investigation of the flow stress are pointed out following a theoretical analysis of the relation between this method and that of the work-hardening parameters. The present results on nickel confirm this relation. Metallographic and X-ray evidence has been obtained in favour of deformation twinning in nickel at 4.2°K and 20°K although no drop in load has been observed of the kind found in copper. Serrations in the recorded load–extension curves indicate discontinuous flow at the lowest temperatures. A.

539.374 : 539.2

3518. THE TWIST IN A CRYSTAL WHISKER CONTAINING A DISLOCATION. J.D.Eshelby.
Phil. Mag. (Eighth Ser.), Vol. 3, 440-7 (May, 1958).

The twist due to a screw dislocation parallel to the axis of an isotropic cylinder of arbitrary cross-section can be found from the solution of the ordinary torsion problem for the same cylinder. Some particular cases are worked out. The results are also valid for certain kinds of anisotropy. A.

539.382 : 531.714

3519. A LATERAL EXTENSOMETER FOR THE DETERMINATION OF POISSON'S RATIO OF ROCK. E.R.Leeman and C.Grobbelaar.
J. sci. Instrum., Vol. 34, No. 12, 503-5 (Dec., 1957).

A lateral extensometer is described by which the lateral strain occurring in a cylindrical rock specimen, subjected to a linear axial compressive load in a compression test, can be read or recorded continuously up to the point of fracture of the specimen. The lateral extensometer was designed to operate in conjunction with a compressometer (Abstr. 8226/1957) which measures the axial strain occurring in the specimen. The measuring element used in the lateral extensometer is a linear variable differential transformer and deformations of the specimen of the order of 1 μin can be measured. The instrument was designed in such a way that it suffers no physical damage when the specimen, to which it is attached, fractures. In fact, over 300 rock specimens were tested using one of these instruments without its accuracy or mechanical condition having been seriously impaired. A.

539.382 : 531.782

A SIMPLE TENSILE TESTING MACHINE FOR VERY FINE WIRES. See Abstr. 2830

539.383 : 531.781

3520. THE EFFECT OF SPECIMEN DIAMETER ON THE STRAINING OF A CYLINDRICAL LOAD-CELL.
J.F.W.Bishop and M.T.Watkins.
Brit. J. appl. Phys., Vol. 9, No. 1, 38-40 (Jan., 1958).

Theoretical and experimental results on the surface axial distortion of a cylindrical load-cell loaded by circular punches of differing diameters are given. It is concluded that a height-to-diameter ratio of about 7 : 4 is required to eliminate end effects and the effect of specimen diameter on the loads recorded near its centre. A.

539.384.4

3521. A PROPERTY OF A BUCKLED ELASTIC ROD.
G.A.V.Leaf.
Brit. J. appl. Phys., Vol. 9, No. 2, 71-2 (Feb., 1958).

One shape assumed by a perfectly elastic rod buckled by appropriate forces and couples at its ends is studied. It is shown that the ratio of maximum height to maximum width is independent of the material of the rod. Also, this ratio is linearly related to the distance between the ends of the rod expressed as a fraction of its length, provided the fraction is roughly less than one half. A.

539.385 : 513.733.5

3522. THE GEOMETRY OF TWISTED MULTI-FILAMENT STRUCTURES. G.J.Stansfield.
Brit. J. appl. Phys., Vol. 9, No. 4, 133-9 (April, 1958).

A self-consistent geometry of cords made from multi-filament yarns is derived from the assumption that all filaments in a cord follow an epihelical path. This path is defined mathematically using a definition of ply twist not considered before, which leads to simpler formulae than those developed by previous workers. Formulae for changes in ply length, ply twist and cord length on cording are dervied, which enable the retraction of cords and yarns on twisting to be predicted accurately. An experimental method of cord twisting (simple twisting) is described which enables a simple experimental verification of this theory of twist to be carried out. A.

539.4.016 : 539.431

3523. A DISCUSSION ON WORK-HARDENING AND FATIGUE IN METALS.
Proc. Roy. Soc. A, Vol. 242, 145-227 (Oct. 29, 1957).

This discussion was held at the Royal Society, London on 21 February, 1957 under the leadership of N.F.Mott. The following papers were read: "Introduction. Work-hardening and the initiation and spread of fatigue cracks", N.F.Mott (145-7); "The mechanism of work-hardening and slip-band formation", J.Friedel (147-59); "The energy stored in fatigued metals", L.M.Clarebrough, M.E.Hargreaves, G.W.West and A.K.Head (160-6); "The hardening and softening of metals by cyclic stressing", T.Broom and R.K.Ham (166-79); "Annealed metals under alternating plastic strain", W.A.Wood and R.L.Segall (180-8); "The initial fatigue crack", G.C.Smith (189-97); "Slip-band damage and extrusion", P.J.E. Forsyth (198-202); "The fatigue and ultimate tensile strengths of metals between 4.2 and 293°K", R.D.McCammon and H.M.Rosenberg (203-11); "Extrusion and intrusion by cyclic slip in copper", A.H.Cottrell and D.Hull (211-13); "Some observations on the fatigue of silver chloride", R.W.K.Honeycombe (213-15); "Some observations on the spread of fatigue cracks", N.E.Frost and C.E.Phillips (216-22); "Speed effects in fatigue", P.G.Forrest (223-7).

539.4.016.2

3524. RECOVERY OF LEAD ROLLED IN LIQUID AIR. Boesono.
Physica, Vol. 24, No. 1, 71-2 (Jan., 1958).

After 70% extension by rolling, the electrical resistivity of commercial Pb shows two recovery steps: one at −115°C, with activation energy 0.48 eV, attributed to the disappearance of vacancies; the second at −30°C, attributed to recrystallization. In pure Pb, the second step occurs at −100°C, and the two steps are not clearly resolved. R.G.Chambers

539.431

3525. A SIMPLE INSTRUMENT FOR THE PERIODIC APPLICATION OF CONTROLLED BI-AXIAL STRAINS. P.U.A.Grossman.
J. sci. Instrum., Vol. 35, No. 4, 131-4 (April, 1958).

The instrument produces harmonically varying strains in a thin layer of a test material and controls in two dimensions the frequencies, amplitudes and phases. Weissenberg's method of a flexible boundary is employed to obtain homogeneous strain and a uniform break-up pattern when fatigue is approached. The specimen adheres to the surface of a rubber sheet which is extended in two directions by sets of parallel strings fastened to sliding carriages. The carriages follow circular cams, one directly and one through a lever. The cams are interconnected by a chain and rotated in rigidly located bearings by hand or motor. Any phase difference is readily set by positioning the chain wheels, and any ratio of amplitudes by shifting the fulcrum of the lever. A ratio of frequencies can be selected by choosing appropriately sized chain-wheels. To illustrate the applications, the fatigue of powders under various testing conditions is described and the emergent break-up patterns are discussed. A.

539.431

3526. THE DETECTION OF FATIGUE IN METALS.
R.F.Hanstock.
Brit. J. appl. Phys., Suppl. No. 6 (Physics of non-destructive testing), S48-S50 (1957).

This is a brief review of the nature of fatigue and of the methods that have been employed or suggested for examining the development of this condition in metals. The primary consideration is the assessment of the potential value of these methods as primitive non-destructive tests to reveal fatigue in its least dangerous stage, i.e. prior to the development of serious structural weakness. A.

539.431

3527. STRUCTURAL CHANGES AND ENERGY DISSIPATION DURING FATIGUE IN COPPER. N.Thompson and N.J.Wadsworth.
Brit. J. appl. Phys., Suppl. No. 6 (Physics of non-destructive testing), S51-S55 (1957).

Simultaneous observations were made of the metallographic

changes visible on the surface, and of the changes in energy dissipation, which take place during the fatigue testing of specimens of fully annealed Cu. The apparatus and methods used are briefly described, and the results summarized. It is maintained that, in this case at least, there is no direct connection between the changes in energy dissipation and the progress towards fatigue failure, and other experiments in support of this thesis are described. A.

539.56 : 539.374

3528. THE GENERATION OF DISLOCATIONS DURING CLEAVAGE. A.J.Forty.
Proc. Roy. Soc. A , Vol. 242, 392-9 (Nov. 5, 1957).

A cleavage crack can generate plastic deformation in a crystal only if it is moving sufficiently slowly or can be brought to rest. This can be demonstrated very strikingly by the cleavage of rock salt or lithium fluoride crystals at a low rate of loading. The cleavage crack propagates discontinuously under these conditions, and thus provides a range of velocities at which deformation might occur. It is found that intense plastic deformation occurs only in narrow zones around the positions where the crack stops; elsewhere the crack runs freely producing a perfect cleavage. It is possible to detect and at the same time estimate the magnitude of this deformation by studying the interference pattern produced by light reflected from the two surfaces of the crack. Observations of this kind allow the deformation to be interpreted as the production of arrays of loops of dislocation by the slowly moving crack. The interference technique is also valuable for displaying the presence of the crack so that its mode of propagation can be studied. A number of observations of the opening and closing of cracks suggest that a study of this kind using a system of reversed stressing might have an important application to the problems of the propagation of fatigue cracks. A.

539.576

3529. TRANSFER OF TUNGSTEN CARBIDE TO SOFT METALS DURING SINGLE-TRAVERSE AND RECIPROCATING SLIDING. J.Golden and G.W.Rowe.
Brit. J. appl. Phys., Vol. 9, No. 3, 120-1 (March, 1958).

This paper describes experiments in which a small radioactive tungsten carbide hemisphere was slid slowly over copper and steel plates. The tungsten carbide transferred to the plates was assessed by counting and autoradiography. On well-prepared copper about 50×10^{-12} g was transferred steadily to each millimetre of track during a single traversal. This carbide was firmly embedded in the copper, even after several traversals in each direction over the track. Single traversals on mild and stainless steels also produced steady embedded wear. However, when reciprocating traversals were made a considerable proportion of the transferred carbide was scattered loosely on the surface. It is suggested that the difference between the first and subsequent traversals on steels is due to the embedded particles acting as abrasives. It is thus important to distinguish between these two phases of wear. A.

539.63 : 532.525

3530. DAMAGE TO SOLIDS BY LIQUID IMPACT AT SUPERSONIC SPEEDS. F.P.Bowden and J.H.Brunton.
Nature (London), Vol. 181, 873-5 (March 29, 1958).

A study was made of the deformation and damage sustained by metallic and plastic specimens subjected to impact by a cylinder of water of about 0.01 cm^3 in volume travelling at about 3100 ft/sec. With a stainless steel specimen, impact produced a shallow saucer-shaped depression with a central pit and a highly deformed annular region just inside the rim of the depression. The area of deformation corresponded closely to the area over which the spreading cylinder exerted pressure. With an Al specimen, the area of the affected surface was similar to that with stainless steel, but the depression was ten times greater. The annular region with metals seemed to have been sheared open by water flowing at high speed over it. The intensity of this deformation increased with the viscosity of the liquid used. With plastic targets, the main feature of the damage was a ring crack on the surface and a central star crack below the surface. Sometimes rear scabbing also occured. Under repeated impact, the cracks spread until a piece of plastic was dislodged from the surface. The flow of liquid parallel to the surface of the specimens was found to be between 2 and 3 times as great as the impact velocity. A.C.Whiffin

539.893 : 537.311.32

LACK OF METALLIC TRANSITION IN LiH AND $LiAlH_4$ UNDER STATIC PRESSURE. See Abstr. 3090

PHYSICAL CHEMISTRY

PHASE EQUILIBRIUM. CHEMICAL REACTIONS

541.123

3531. EXCHANGE OF AMMONIA BETWEEN METAL-AMMINE CATIONS AND SOLVENT IN LIQUID AMMONIA.
H.U.D.Wiesendanger, W.H.Jones and C.S.Garner.
J. chem. Phys., Vol. 27, No. 3, 668-72 (Sept., 1957).

The rates of exchange of NH_3 between solvent liquid ammonia and ligand ammonia in five metal-ammine cations were measured with N^{15} labelling. Reactants were separated by distilling off the solvent ammonia. Within the exchange times of 0.5, 3, and 11 minutes, respectively, exchange is complete for $Ag(NH_3)_2^+$, $Cu(NH_3)_4^{+2}$, and $Ni(NH_3)_6^{+2}$ at concentrations of ~ 0.01 f and in the dark at -33.5^0C. Based on a single run, exchange with 0.013 f $Cr(NH_3)_6^{+3}$ in the dark at 25.0°C exhibited a good McKay plot with a half-time of 1500 min, corresponding to a bimolecular rate constant $k = 1.3 \times 10^{-6}$ l·mole^{-1}.sec^{-1}. Exchange with $Co(NH_3)_6^{+3}$ was shown to be slow (half-times of the order of several hours at 0.002-0.005 f in the dark at 25.0°C), but reproducible results were not obtained. All complexes were studied as the nitrates. The observed slow exchange for $Cr(NH_3)_6^{+3}$ and $Co(NH_3)_6^{+3}$ is consistent with their classification as "inert inner-orbital" complexes. Exchange of N^{15} between NO_3^- and solvent liquid ammonia, including exchange during the hot NaOH treatment used to distill off the ammonia, is less than 3% at 0.05 f NO_3^- and 25°C. A.

541.126

3532. REACTIONS OF NITROGEN ATOMS. I. OXYGEN AND OXIDES OF NITROGEN. G.B.Kistiakowsky and G.G.Volpi.
J. chem. Phys., Vol. 27, No. 5, 1141-9 (Nov., 1957).

Several reactions of nitrogen atoms were investigated in a low-pressure flow system, using the principle of a "stirred reactor" and a mass spectrometer for the determination of steady-state concentrations. The elementary processes which have been definitely demonstrated to occur and their rate constants are as follows:

$N + NO = N_2 + O$	$k_1 \geq 4 \times 10^{11}$ cm^3 mole^{-1} sec^{-1}
$N = O_2 = NO + O$	$k_8 = 2 \times 10^{12} \times \exp(-6200/RT)$ cm^3 mole^{-1} sec^{-1}
$N + NO_2 = N_2O + O$	$10^{-2}k_1 < k_9 < 10k_1$ (a)
$O + NO = NO_2$	$k_3 \geq 10^{13}$ cm^3 mole^{-1} sec^{-1}
$O + NO_2 = O_2 + NO$	$k_6 \geq 10^{12}$ cm^3 mole^{-1} sec^{-1}.

Unless indicated, the rate constants are at room temperature. The rate constant of nitrogen atom reaction with nitrous oxide is less than 10^6 cm^3 mole^{-1} sec^{-1} at 280°; that of oxygen atoms is less than 2×10^8 at room temperature, neither having been observed to occur. Nitrogen atoms probably react with nitrogen dioxide also by a different mechanism than (a), yielding 2NO and/or $N_2 + O_2$, at a rate which is competitive with (a). Nitrous oxide is probably formed also by another mechanism, which does not involve nitrogen atoms and may well be the reaction of vibrationally excited nitric oxide with nitrogen dioxide. The accomodation coefficient of glass walls, treated with phosphoric acid, for the recombination of oxygen atoms, was determined as 10^{-4} in one reactor and was larger than this in another. A.

541.126

3533. REACTIONS OF NITROGEN ATOMS. II. H_2, CO, NH_3, NO, AND NO_2. G.B.Kistiakowsky and G.G.Volpi.
J. chem. Phys., Vol. 28, No. 4, 665-8 (April, 1958).

The reactions of H_2, CO, and NH_3 with nitrogen atoms are too slow for detection either at room temperature or in the neighbourhood of 250° in a low pressure "stirred" reactor flow system with a mass spectrometer as the analytical device, the rate constants being less than 10^8 cm^3 mole^{-1} sec^{-1}. The addition of these gases to active nitrogen causes no qualitative changes in the spectrum of the afterglow. In presence of ammonia the intensity of the afterglow is

reduced, the inverse of the intensity being linear in the pressure of ammonia. The observations, coupled with the data in the literature, are interpreted as evidence that a transfer of electronic energy takes place between the excited nitrogen molecules, the emitters of the afterglow and ammonia molecules. Excitation of ammonia is followed by its dissociation. A modified flow apparatus, more suitable for the study of fast reactions, was used to reinvestigate the reactions of nitrogen atoms with NO and NO_2. Only the lower limit of the rate constant of the reaction $N + NO = N_2 + O$, namely 5×10^{13} cm^3 mole^{-1} sec^{-1}, could be estimated. The rate of the reaction with NO_2 was also too fast to measure, but the lower limit of the rate constant is less certain. A.

541.126

3534. THERMAL EXCHANGE OF IODINE WITH METHYL IODIDE AND WITH HYDROGEN IODIDE IN THE GAS PHASE.
H.Schmied and R.W.Fink.
J. chem. Phys., Vol. 27, No. 5, 1034-40 (Nov., 1957).

This was studied between 60° and 140° C. The exchange is strongly surface sensitive and follows the rate law: $R = k_1(CH_3I)(I_2) + k_2(CH_3I)$. The exchange proceeds by means of two competing mechanisms, one of which is independent of iodine concentration and possibly involves the formation of CH_3· free radicals on the surface which then react with I_2. This heterogeneous reaction may be eliminated by preheating the reaction vessel overnight at 550° C, which reduces the reaction to a simple bimolecular exchange following the rate law: $R = (CH_3I)(I_2)(2.5 \times 10^6) \exp(-9000/RT)$ mole.cm^{-3}.sec^{-1} which was obtained specifically for a surface/volume ratio of 1.19 cm^{-1}. The formation of a complex between CH_3I and I_2 was studied spectrophotometrically in dry n-heptane. The heat of formation of the complex was found to be −4.5 kcal.mole^{-1}, and the entropy of formation was found to be −25.8 cal.deg^{-1}.mole^{-1} for a standard state of 1 mole.litre^{-1}. The formation of a complex between HI and I_2 also was established in dry n-heptane. The gaseous exchange of HI with I_2 was found to be so fast that kinetic data could not be obtained. A theoretical estimate of the exchange half-life assuming an atomic iodine mechanism shows that the reaction would be rapid; however, experimental evidence is presented which suggests that a bimolecular mechanism is more likely.

A.

541.126

3535. INVESTIGATIONS OF THE DETONATION PROPERTIES OF CONDENSED EXPLOSIVES WITH EQUATIONS OF STATE BASED ON INTERMOLECULAR POTENTIALS. I. R.D.X. WITH FIXED PRODUCT COMPOSITION.
W.Fickett, W.W.Wood and Z.W.Salsburg.
J. chem. Phys., Vol. 27, No. 6, 1324-30 (Dec., 1957).

An attempt is made to determine an average pair potential of intermolecular force for the mixture of product gases of the condensed explosive R.D.X. (cyclotrimethylenetrinitramine) from measurements of the detonation velocity. The principal approximations are that the products of detonation consist of CO, H_2O, and N_2 in equimolar proportions and that the equation of state for this mixture can be calculated from theories of the free-volume type with the use of an average intermolecular potential. It was found that the average intermolecular potential was fairly well determined at distances somewhat less than the crossover distance. This result was almost independent of the choice of equation of state, although the calculated values of detonation temperature and pressure were not. A.

541.127 : 537.226.2

3536. DIELECTRIC DISPERSION OF BORIC ACID IN WATER. THE RATE OF RECOMBINATION OF H^+ AND $H_2BO_3^-$ AT 35°C.
W.R.Gilkerson.
J. chem. Phys., Vol. 27, No. 4, 914-17 (Oct., 1957).

A novel method has been developed for the measurement of the rates of fast ionic reactions in solution. The application of an alternating electrical field to a solution containing a system in mobile equilibrium, such as $HA \rightleftharpoons H^+ + A^-$, causes a small shift in this equilibrium. The shift, to produce more ions, lags behind the changing field and causes an absorption of energy from the field. Measurement of the dielectric constant and loss factor of the solution allows the determination of the relaxation time due to the shift in equilibrium. This is related to conventional rate constants. The method has been applied to the reaction $H^+ + H_2BO_3^-$ in water at 35°C. The rate constant was determined to be 1.3×10^{10} M^{-1} sec^{-1} at this temperature. A.

541.127

3537. RATES AND MECHANISMS OF PROTOLYSIS OF DI- AND TRIMETHYLAMMONIUM IONS STUDIED BY PROTON MAGNETIC RESONANCE. A.Loewenstein and S.Meiboom.
J. chem. Phys., Vol. 27, No. 5, 1067-71 (Nov., 1957).

A kinetic analysis of the protolysis reactions of di- and trimethylammonium ions in aqueous solution was carried out using the nuclear magnetic resonance technique. The results complement those of a similar study of methylammonium ion reported in Abstr. 1358 (1958). In the pH range studied (between 3 and 5) the main mechanism is: $RNH^+ + RN \rightleftharpoons RN + RNH^+$. The reaction involves water in nearly every exchange. The measured rate constants are: 6.0×10^8 and 3.1×10^8 sec^{-1} M^{-1} for di- and trimethylammonium, respectively. A.

541.127

3538. KINETICS AND EQUILIBRIA OF COMPLEX REACTIONS.
C.A.Hollingsworth.
J. chem. Phys., Vol. 27, No. 6, 1346-8 (Dec., 1957).

The kinetics of complex reversible reactions is treated by a method that clarifies the relationship between the rate laws and the thermodynamic condition for equilibrium. It is shown that this relationship takes on simple forms only under very special conditions. Some of the equations obtained appear to be useful for the treatment of certain types of complex rate processes. The theory of steady-state diffusion in the presence of an external field is treated briefly. A.

ELECTROCHEMISTRY

541.132

3539. IONIZATION OF STRONG ELECTROLYTES. V. PROTON MAGNETIC RESONANCE IN SULFURIC ACID.
G.C.Hood and C.A.Reilly.
J. chem. Phys., Vol. 27, No. 5, 1126-8 (Nov., 1957).

For Pt IV see Abstr. 1693 (1956). The proton magnetic resonance shifts in solutions of sulphuric acid were measured and degrees of dissociation calculated. The results are consistent with information derived from the intensities of Raman lines. A.

541.132

3540. IONIZATION OF STRONG ELECTROLYTES. VI. NUCLEAR MAGNETIC RESONANCE AND DISSOCIATION OF HEPTAFLUOROBUTYRIC ACID. G.C.Hood and C.A.Reilly.
J. chem. Phys., Vol. 28, No. 2, 329-30 (Feb., 1958).

Proton and fluorine magnetic resonance of heptafluorobutyric acid in water were measured and used to estimate a dissociation constant of 1.1. The effects of electrolytic dissociation below a mole fraction 0.5 and of dimerization and hydration above 0.5 are similar to those found for trifluoroacetic acid. A.

541.133.08 : 538.082 : 621.317.41

3541. AN ELECTRODELESS METHOD FOR THE MEASUREMENT OF ELECTROLYTIC CONDUCTIVITY AND MAGNETIC SUSCEPTIBILITY. W.R.Myers.
J. sci. Instrum., Vol. 35, No. 5, 173-5 (May, 1958).

Simultaneous measurement of electrolytic conductivity and magnetic susceptibility is achieved by observing the changes in output voltage of a transformer when its air core is filled with a specimen. Conductivity measurements for strong electrolytes were obtained, in which departures from accepted values are less than 0.07 mho m^{-1} in the range from 1 to 30 mho m^{-1}. The magnetic measurements generally have less precision, and errors of 2% occur for susceptibilities of the order of 10^{-11} H/m. A.

541.135.2

3542. THE PREPARATION OF THIN FILMS OF PLUTONIUM, AMERICIUM AND CURIUM BY AN ELECTROLYTIC METHOD.
G.N.Yakovlev, P.M.Chulkov, V.B.Dedov, V.N.Kosyakov and Y.P.Sobolev.
J. nuclear Energy, Vol. 5, No. 1, 159-61 (1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 5, 131-3 (1956).

Methods and apparatus are described for quantitative electrodeposition of these transuranic elements on metallic surfaces from both neutral and weakly acidic alcoholic solutions of the chlorides. Best results were given by electrolysis from neutral solutions of trivalent chlorides. L.Bovey

541.135.5 : 548.5

3543. ELECTRODEPOSITION ONTO METAL WHISKERS.
D.A.Vermilyea.
J. chem. Phys., Vol. 27, No. 3, 814-15 (Sept., 1957).

Electrodeposition occurs only at isolated sites along the (Cu) whisker when the latter has a diameter of a few microns and requires high overvoltages (> 100 mV). This behaviour is in contrast to that of larger diameter (> 10 μ) Cu whiskers which behaved during electrolysis like ordinary pieces of Cu wire. These results suggest the relative (crystal) perfection of whiskers of small diameter. W.Good

541.135.5

3544. STANDARD ELECTRODE POTENTIAL OF THE SILVER, SILVER CHLORIDE ELECTRODE. E.L.Purlee and E.Grunwald.
J. chem. Phys., Vol. 27, No. 4, 990 (Oct., 1957).

A description is given of the preparation of the electrode with a reproducibility of 0.05 mV, even when it is to be used in solvents of low dielectric constant. W.Good

541.136.3

3545. EFFECT OF INTRODUCING Li IN THE POSITIVE PLATES OF Ni ACCUMULATORS. I.Sanghi and W.F.K.Wynne-Jones.
J. sci. industr. Res., Vol. 16B, No. 8, 376-7 (Aug., 1957).

Following the improved performances of alkaline accumulators by the addition of lithium hydroxide to the electrolyte, the authors examined the effect of, and describe, the inclusion of lithium in the nickel oxide lattice. The resulting oxide became black instead of green and was electrochemically inactive. The change from ionic to electronic mode of conduction in the plate as prepared rendered it inefficient for accumulator use. W.A.Walker

PHOTOCHEMISTRY. RADIATION CHEMISTRY

541.14

3546. EFFECT OF ILLUMINATION ON THE OXIDATION OF COPPER SINGLE CRYSTALS IN WATER. J.Kruger.
J. appl. Phys., Vol. 28, No. 10, 1212-13 (Oct., 1957).

Experiments are described which show that irradiation by white light retards the growth of oxide film in the oxidation of copper single crystals in air-saturated distilled water. An explanation is suggested based on a theory of Mott's for copper–cuprous oxide photocells. W.Good

541.14

3547. PHOTOCHEMICAL FORMATION OF NITROUS OXIDE.
W.E.Groth and H.Schierholz.
J. chem. Phys., Vol. 27, No. 4, 973-4 (Oct., 1957).

This is brought about by irradiating mixtures of nitrogen and oxygen with the resonance wavelengths of xenon at 1470 and 1295 A. About 0.01% of the oxygen atoms reacted with nitrogen to form N_2O. The results are important in connection with the interpretation of the origin of N_2O in the atmosphere. W.Good

541.15 : 535.379

3548. THE CHEMICAL ACTION OF ULTRASONIC WAVES.
A.V.M.Parke and D.Taylor.
J. Chem. Soc., 1956, 4442-50 (Nov.).

Spectra of the sonoluminescence from aerated bromine water and from aerated aqueous CS_2 solution were examined with a resolution not better than 100 A. In each case, a broad band in the visible region was detected. For water containing argon, air, oxygen, or nitrogen the intensity of sonoluminescence as measured by a photomultiplier increased with time of irradiation up to equilibrium values that varied linearly with ultrasonic power. Oxidation due to ultrasonic waves increased linearly w th time of irradiation in the solutions O_2–H_2O, O_2–KI–H_2O, air–KI–CCl_4–H_2O, A–H_2O, N_2–H_2O, while for the first three the rate of oxidation increased linearly with both ultrasonic power and the intensity of sonoluminescence. For oxygen–water solutions, addition of salts (except KI) and of H_2SO_4 had no effect on the luminescence or oxidation, but for O_2–KI–H_2O solutions a three-fold increase in the rate of liberation of iodine occurred without change in luminescence when the pH was reduced from about 7 to 2. Nuclear hydroxylation of aromatic molecules when irradiated in aqueous solution was observed. The results are discussed in the light of current theories for the action of ultrasonic waves. A.

DISPERSIONS. COLLOIDS. ADSORPTION

541.183.26

3549. ADSORPTION OF ACTIVATED GASES.
D.G.Bills and N.P.Carleton.
J. appl. Phys., Vol. 29, No. 4, 692-7 (April, 1958).

The adsorption of gases activated by electron bombardment was investigated theoretically and experimentally. From postulates concerning probabilities of adsorption and deactivation for activated molecules in collision with surfaces an expression is derived giving the rate of adsorption in terms of these probabilities and of the amount of activated gas already adsorbed on the surfaces. This relation is also determined experimentally by a new method in which constant pressure is maintained in the adsorption vessel by admitting gas to it from a resevoir through a controlled leak, while the adsorption is taking place. The theoretical expression fits the experimental data, suggesting that the assumptions of the theory are essentially correct. From numerical values obtained under various experimental conditions some information is derived about the processes involved in adsorption of activated gases. A.

CHEMICAL ANALYSIS

545.1 : 531.752

3550. NEW TYPES OF RECORDING DIFFERENTIAL THERMOBALANCES. P.L.Waters.
J. sci. Instrum., Vol. 35, No. 2, 41-6 (Feb., 1958).

Two types of thermobalance are described, which automatically record both the differential and cumulative weight losses during pyrolysis of samples. In both balance systems displacement of the balance beam due to changes in the weight of sample is converted into an electrical signal; the amplified signal operates a servomechanism, which applies the counterbalancing force at the necessary rate. The servomechanisms differ in the two types. In one, an analytical balance is adapted so that the sample is counterbalanced by the suspended electrode of a silver coulometer, the controlling current passing through the cell giving a measure of the rate at which the sample loses weight. In the other, a servomotor rotates the head of a torsion balance to maintain equilibrium; the rate of weight loss is proportional to the speed of the motor and to the voltage applied to it. Alternative control circuits are mentioned. The present torsion-type differential thermobalance can record total weight changes up to 0.5 g at a maximum rate of 30 mg/min. The cumulative change in weight is registered to the nearest 0.1 mg on the dial counters, and 1 mg on the recorder chart; the differential weight change can be read to within 0.2 mg/min. As the differential weight loss is sensitive to variation in heating rate, a linear-rate controller capable of high accuracy was specially designed for use with the thermobalance. A.

545.823

3551. THE APPLICATION OF VACUUM ULTRA-VIOLET TECHNIQUES TO THE CONTINUOUS MONITORING OF TRACE CONCENTRATIONS OF WATER IN SEVERAL GASES.
W.R.S.Garton, M.S.W.Webb and P.C.Wildy.
J. sci. Instrum., Vol. 34, No. 12, 496-500 (Dec., 1957).

A method for the determination of water in several gases is outlined, in which use is made of the absorption bands of the water molecule in the 1200 A region. A 20 Mc/s electrodeless discharge in hydrogen excites the 1216 A Lyman α line very strongly and relatively free from neighbouring lines and bands. The radiation passes through the absorption cell, closed at both ends by LiF windows, on to the W cathode of a photomultiplier, which is insensitive to light of wavelength longer than 1400 A. A.

CRYSTALLOGRAPHY

548.0 : 537.228.1

3552. SYMMETRY AND PIEZOELECTRIC PROPERTIES OF CRYSTALS AND TEXTURES. I.S.Zheludev.
Kristallografiya, Vol. 2, No. 1, 89-98 (1957). In Russian.

A theoretical discussion is given of the principles governing the division of crystals and textures into piezoelectric and non-piezoelectric classes. The possibility of some piezoelectric effects occurring in cubic crystals belonging to the point group 432 is also considered. R.F.S.Hearmon

548.0 : 535.323

3553. REFRACTOMETRIC DETERMINATION OF THE STRUCTURE OF COMPLEX COBALT COMPOUNDS. S.S.Batsanov.
Kristallografiya, Vol. 2, No. 2, 268-73 (1957). In Russian.

The geometrical configuration is determined by comparing the experimentally measured refractive indices with those calculated for different isomeric forms. Data are given for density, refractive index and dispersion in a number of complex compounds of trivalent cobalt. R.F.S.Hearmon

548.12 : 512.94

3554. SYMMETRY OF SCALARS, VECTORS AND SECOND RANK TENSORS. I.S.Zheludev.
Kristallografiya, Vol. 2, No. 2, 207-16 (1957). In Russian.

The formulae for transforming the components of scalars, polar and axial vectors, and tensors are recapitulated. The canonic forms and symmetries of these quantities and various combinations of them are tabulated. New symmetry groups are found; the total number of such groups is limited to 17, and the geometrical forms of these are illustrated diagrammatically. R.F.S.Hearmon

548.12

3555. SYMMETRY OF HOMOGENEOUS CONTINUOUS ISOTROPIC BODIES IN TENSOR, VECTOR AND SCALAR FIELDS. I.S.Zheludev.
Kristallografiya, Vol. 2, No. 3, 334-9 (1957). In Russian.

The 17 groups (see preceding abstract) for an isotropic medium in fields described by second-order polar and axial tensors are considered in detail. R.F.S.Hearmon

548.24

3556. X-RAY DETERMINATION OF CONJUGATE DEFORMATION TWINS IN COPPER. F.A.Sherrill, M.C.Wittels and T.H.Blewitt.
J. appl. Phys., Vol. 28, No. 5, 526-9 (May, 1957).

Deformation twins related to two separate (111) orientations were observed in a Cu single crystal deformed by tensile extension at 4.2°K. The unambiguous determination of the twin relationships is accomplished by a unique X-ray technique, which makes use of a single crystal adaptor and Geiger counter methods. The adaptor permits the detection and measurement of weakly diffracting reflections, and the twin relationships are established by the unique application of geometrical data in a stereographic projection. (See also following abstract.) A.

548.24

3557. EXAMINATION OF THE VALIDITY OF THE CRITICAL RESOLVED TWINNING STRESS HYPOTHESIS. A.R.Rosenfield.
J. appl. Phys., Vol. 29, No. 2, 227-8 (Feb., 1958).

Recent experimental evidence by Sherril et al. (see previous abstract) showed that conjugate deformation twins occur in Cu. It is shown that this twinning occurred, not on the systems most favourably orientated, but on the systems next most favourably orientated; thus the validity of the hypothesis is in doubt. W.Bardsley

548.3

3558. CRYSTAL CHEMISTRY OF METALLIC HEXABORIDES. G.S.Zhdanov, N.N.Zhuravlev, A.A.Stepanova and M.M.Umanskii.
Kristallografiya, Vol. 2, No. 2, 289-90 (1957). In Russian.

Data are assembled for cell dimensions of hexaborides of various metals, and are discussed in relation to valency and position in the periodic table of the respective metals. X-ray determinations of the thermal expansion of CaB_6 and SiB_6 are reported and compared with earlier values for other metallic hexaborides. R.F.S.Hearmon

548.3

3559. INVESTIGATION OF THE DISTRIBUTION OF ACTIVATORS IN ALKALI HALIDE CRYSTALS BY THE RADIOACTIVE INDICATOR METHOD. L.M.Belyaev, V.A.Perl'shtein and V.P.Panova.
Kristallografiya, Vol. 2, No. 3, 437-40 (1957). In Russian.

Crystals of KI, NaI, CsI containing radioactive Tl^{204} and Ag^{110} were grown by the Kyropoulos and Obreimov–Shubnikov methods. The distribution of Tl and Ag in the resulting crystals was found by standard radioactive techniques to be non-uniform in all cases. R.F.S.Hearmon

548.4 : 537.226.2

POLARIZATION CHARACTERISTICS OF ROCHELLE SALT CRYSTALS CONTAINING IMPURITIES. See Abstr. 3071

548.5

3560. THE HYDROTHERMAL SYNTHESIS OF SCHEELITE. I.N.Anikin.
Kristallografiya, Vol. 2, No. 1, 195-7 (1957). In Russian.

Some features of the behaviour of $CaWO_4$ in relation to various electrolyte solutions at temperatures between 350 and 500° C, and pressures between 300-320 atm., are described. Crystals of scheelite, measuring about 1/2 mm, were produced from powdered $CaWO_4$ at 300 atm. and 380° C. R.F.S.Hearmon

548.5 : 541.135.5

RELATIVE CRYSTAL PERFECTION OF SMALL AND LARGE COPPER WHISKERS. See Abstr. 3543

548.52

3561. CRYSTAL GROWTH OF SILVER METAL. MECHANISM AND KINETICS. W.G.Courtney.
J. chem. Phys., Vol. 27, No. 5, 1349-56 (Dec., 1957).

The crystal growth of silver-metal whiskers and "ferns" occurring in the reduction of Ag(I) with Fe(II) from aqueous perchlorate solution was directly observed under the microscope. Whiskers frequently grew at well-defined angles to the previous direction and occasionally stopped growing abruptly although nearby whiskers continued to grow. In fern growth, short spikes grew in a regular manner from only one side of a parallel-sided main stem. Linear growth rates of whiskers were essentially independent of an estimated eightfold variation in supersaturation, but the growth rate of a whisker occasionally increased abruptly in approximately integral ratios. Whisker and fern growth are qualitatively attributed to perfect and twinned screw dislocations, respectively, but no explanation is offered for the formation of whisker and fern habits. It is shown that an interpretation of growth habit will require the Burton, Cabrera, and Frank treatment of infinite surfaces to be extended to the edges and corners of a crystal. Limited kinetic data suggest that the size of the critical surface nucleus was independent of supersaturation, which is contrary to the classical theory of crystal growth. A possible explanation for constant-sized critical surface nuclei is offered. A.

548.52

3562. INVESTIGATION OF THE DYNAMICS OF ELEMENTARY PROCESSES OF GROWTH AND EVAPORATION OF CRYSTALS. G.G.Lemmlein, E.D.Dukova and A.A.Chernov.
Kristallografiya, Vol. 2, No. 3, 428-36 (1957). In Russian.

Earlier results (Abstr. 8261-2/1957) on the formation of screw dislocations and on the mutual approach and annihilation of two dislocations of opposite sign are reviewed and discussed in detail. R.F.S.Hearmon

548.52

3563. SPIRAL GROWTH OF SILICON CRYSTALS. N.A.Shamba and N.N.Sheftal'.
Kristallografiya, Vol. 2, No. 3, 441-4 (1957). In Russian.

A discussion, illustrated by photographs, of the importance of spiral growths in the crystallization of silicon from the melt. R.F.S.Hearmon

548.523

3564. OBSERVATION OF THE LAYER-SPIRAL GROWTH OF CRYSTALS FROM SOLUTION. M.I.Kozlovskii.
Kristallografiya, Vol. 2, No. 1, 153-7 (1957). In Russian.

The conditions required for producing spiral growth crystals of naphthalene from kerosene solution are established. The mechanism

of growth from solution is similar to that from the gaseous phase. Data are given for the dependence of tangential growth velocity on layer thickness and degree of supersaturation. R.F.S.Hearmon

548.523

3565. THE GROWTH OF INORGANIC SALT WHISKERS FROM SOLUTION. P.Charsley and P.E.Rush.
Phil. Mag. (Eighth Ser.), Vol. 3, 508-12 (May, 1958).

Whiskers of sodium chloride, potassium chloride, copper sulphate and sodium nitrate, grown from aqueous solution, studied by optical and electron microscopy. The results lead to the conclusion that growth is in two stages: an initial linear growth and subsequent whisker thickening by two-dimensional nucleation. This picture of whisker growth is in accordance with a theory which has been proposed by Sears (1949). Certain direct electron microscope results suggest that the mechanism of whisker thickening is responsible for the known decrease in strength with increasing diameter. A.

548.524

3566. KINETICS OF SPHERULITE GROWTH IN HIGH POLYMERS. B.B.Burnett and W.F.McDevit.
J. appl. Phys., Vol. 28, No. 10, 1101-5 (Oct., 1957).

Spherulite growth rates have been measured in two polyamides, 66 and 6 nylon, at temperatures ranging from 38 to 141° below the melting points, using a moving photomicrographic technique. At constant temperature, the spherulite radius increases at a constant rate. This isothermal growth rate constant is temperature dependent, having low values just below the melting point, passing through a maximum on further supercooling and decreasing to negligible values at room temperature. These facts indicate that spherulite growth is not a diffusion-controlled process. A reasonable interpretation of the data has been obtained using the concept of growth by two-dimensional surface nucleation. A theoretical expression for the temperature dependence of the growth rate based on this concept has given good agreement with the experimentally determined values. (See also following abstracts). A.

548.524

3567. ON SPHERULITE FORMATION. A.V.Shubnikov.
Kristallografiya, Vol. 2, No. 3, 424-7 (1957). In Russian.

It is shown from energy considerations that crystals may form as spherulites rather than in columnar or lamellar form. (See also following abstract). R.F.S.Hearmon

548.524

3568. EMBRYONIC FORMS OF SPHERULITES. A.V.Shubnikov.
Kristallografiya, Vol. 2, No. 5, 584-9 (1957). In Russian.

Different forms of spherulites in the initial stages of their formation are described, and the conditions established under which the different forms occur. (See also preceding abstracts). R.F.S.Hearmon

548.55 : 669.041 : 621.365.3

3569. AN IMPROVED CZOCHRALSKI CRYSTAL-PULLING FURNACE. K.H.J.C.Marshall and R.Wickham.
J. sci. Instrum., Vol. 35, No. 4, 121-5 (April, 1958).

A furnace suitable for pulling single crystals of Ge and Si was constructed. This apparatus differs from previous designs in that it combines rapidity of set-up with ease of operation and almost perfect vision during the crystal-growing cycle. The heating element is of resistance-heated graphite and provision is made for growing either in vacuum or in an inert gas atmosphere. A.

548.572

3570. RIBBED FORMS AND STRIATIONS ON CRYSTALS. V.I.Mikheev and I.I.Shafranovskii.
Kristallografiya, Vol. 2, No. 1, 166-71 (1957). In Russian.

Simple ribbed forms are investigated in systems of low and medium symmetry. These forms correspond to possible striations on the surfaces of crystals. The role of striations in studying the genesis of crystals and in their identification is pointed out. R.F.S.Hearmon

548.574 : 532.528

3571. SOME EXPERIMENTAL DATA ON THE NATURE OF THE FORMATION OF ETCH FIGURES IN AN ULTRASONIC FIELD. Kh.S.Bagdasarov and V.Ya.Khaimov-Mal'kov.
Kristallografiya, Vol. 2, No. 2, 309-10 (1957). In Russian.

In an attempt to explain the formation of etch figures on NaCl in an ultrasonic field, the strength of NaCl crystals was measured in air, in moving and in still water, and in water, when exposed to ultrasonic fields of frequencies 717 and 22 kc/s. A marked reduction in strength was found at 22 kc/s, which is attributed to the formation of micro-flaws by cavitation effects. It is concluded that the formation of etch figures can also be explained in terms of these cavitation effects. R.F.S.Hearmon

548.574 : 539.373

3572. ETCH FIGURES ON SLIP LINES AND ON POLYGONAL BLOCKS IN SILVER CHLORIDE CRYSTALS. M.P.Shaskol'skaya and Yu.Kh.Vekilov.
Kristallografiya, Vol. 2, No. 4, 548-51 (1957). In Russian.

Prolonged high-temperature annealing causes polygonization in silver chloride crystals previously plastically deformed; when etched, such crystals show etch pits aligned in rectangular nets. On crystals deformed after annealing, etch pits appear only along the wavy slip lines. A gradual displacement of grain boundaries can be brought about by etching. R.F.S.Hearmon

548.574

3573. SPIRAL PITS ON SILICON CARBIDE. V.G.Bhide.
Nature (London), Vol. 181, 1006-7 (April 5, 1958).

Terraced pits were observed on silicon carbide crystals, with step heights of 27 ± 2 A and 1050 A. The structure of the pits indicates that evaporation takes place in accordance with a dislocation mechanism. J.Franks

548.575

3574. MACROSCOPIC EDGE DISLOCATIONS IN CRYSTALS OF CORUNDUM. V.L.Indenbom and G.E.Tomilovskii.
Kristallografiya, Vol. 2, No. 1, 190-2 (1957). In Russian.

A theoretical discussion, illustrated by photographs, of the effects observed when an edge discloation is viewed in polarized light, and the relation of the effects to the state of internal stress near the dislocation. R.F.S.Hearmon

X-RAY CRYSTALLOGRAPHY

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classsification 539.26/.27

548.73

3575. ELECTRON DENSITY DISTRIBUTIONS IN CRYSTALS. H.J.Grenville-Wells.
Rev. mod. Phys., Vol. 30, No. 1, 171-2 (Jan., 1958).

Describes a programme for future work on distinguishing between the various possible causes of anisotropy in experimentally determined electron density distributions. D.M.Edwards

548.732

3576. ON THE REPRESENTATION OF ATOMS IN CRYSTALS IN THE FORM OF SYMMETRIC FIGURES. S.T.Konobeevskii.
Kristallografiya, Vol. 2, No. 4, 447-55 (1957). In Russian.

A development of earlier work (Abstr. 5443/1952) on the determination of atomic shape and electron density distribution in crystals by comparing the maximum intensities in the X-rays diffracted from various planes. R.F.S.Hearmon

548.733

3577. AN OXIDIZING ATMOSPHERE FURNACE FOR USE WITH AN X-RAY DIFFRACTOMETER. S.W.Kennedy and L.D.Calvert.
J. sci. Instrum., Vol. 35, No. 2, 61-2 (Feb., 1958).

A resistance furnace assembly to fit the "Norelco" diffractometer is described. It makes possible the investigation of rigid specimens of powders in controlled atmospheres of vacuum. A.

548.734

3578. AUTOMATIC SYNTHESIS OF TWO-DIMENSIONAL REPRESENTATIONS OF ATOMIC STRUCTURES. V.I.Vlasenko and G.S.Zhdanov.
Kristallografiya, Vol. 2, No. 3, 358-65 (1957). In Russian.

An all-electronic method is described for rapidly displaying an electron-density map on a cathode-ray tube screen. R.F.S.Hearmon

548.734 : 771.534.5

3579. STUDIES IN MICRODENSITOMETRY. W.A.Wooster and J.A.L.Fasham.
J. sci. Instrum., Vol. 35, No. 5, 153-6 (May, 1958).

A discussion is given of some factors which affect all microdensitometer studies on X-ray photographs. The particular problems that affect powder photographs, preferred orientation photographs,

single crystal photographs and diffuse reflection photographs are then considered. The use of a rotating circular stage for the investigation of rings of varying density and the use of an integrating mechanism for the determination of the integrated reflection in a line or spot are described. A.

548.734 : 539.26

THE POTENTIALITIES OF X-RAY DIFFRACTION STUDIES IN NON-DESTRUCTIVE TESTING. See Abstr. 3494

548.734.3 : 535.822.1

3580. MODIFICATIONS TO A TRAVELLING MICROSCOPE USED FOR MEASURING X-RAY POWDER PHOTOGRAPHS.
W.E.Armstrong and R.J.Davis.
J. sci. Instrum., Vol. 35, No. 2, 59-61 (Feb., 1958).

The cross-hairs in the microscope eyepiece were removed and the reference mark was obtained from a light spot thrown on the photograph from a projector clamped to the barrel of the microscope. Cross-hairs seen in silhouette tend to obscure faint lines on the photograph and prevent their measurement. The light spot eliminates this effect, allows change of magnification for measuring different lines without moving the reference mark, eliminates parallax and allows the use of a binocular eyepiece. These features reduce eyestrain while measuring a photograph, and improve the accuracy of measurement of faint or diffuse lines. The photograph is illuminated by a short fluorescent tube, the light of which is cooler and "harder" in quality than that of filament lamps. Means are described of adjusting the light intensity of the tube over a wide range. A.

548.735

3581. SUMMARIZED PROCEEDINGS OF A CONFERENCE ON BIOLOGICAL STRUCTURES AND COMPUTATIONAL METHODS — LONDON, NOVEMBER 1956.
J.Finch, D.W.Green, K.G.Holmes and A.C.P.North.
Brit. J. appl. Phys., Vol. 9, No. 1, 1-12 (Jan., 1958).

Annual conference of the X-ray Analysis Group of the Institute of Physics. The three sessions dealt with crystallographic computing for large molecules; globular and fibrous proteins; and viruses and nucleic acids. A.

548.735.4

3582. THE THEORY OF THE CONNECTION OF STRUCTURE AMPLITUDES AND THE DIRECT METHOD OF CRYSTAL STRUCTURE ANALYSIS. A.I.Kitaĭgorodskiĭ.
Kristallografiya, Vol. 2, No. 3, 352-7 (1957). In Russian.

A discussion of the law of predominant positivity of structure products, and its application to the direct analysis of structures. R.F.S.Hearmon

548.736.1

3583. X-RAY DETERMINATION OF THE NUMBER OF 3d ELECTRONS IN Cu, Ni, Co, Fe, AND Cr.
R.J.Weiss and J.J.DeMarco.
Rev. mod. Phys., Vol. 30, No. 1, 59-62 (Jan., 1958).

The technique adopted was to measure the absolute X-ray scattering factors and to subtract the effect of the "argon core" as calculated from the self-consistent field method. This leaves the contribution from the 3d, 4s and 4p electrons of which the scattering factors of the 4s and 4p electrons are negligible. Corrections were made for extinction, surface roughness, dispersion, thermal vibration, and absorption. Care was also taken that the X-ray measurements were on an "absolute" basis. It was concluded that in Cu, Ni and Co most of the electrons outside the "argon core" are in atomic 3d states, while in Fe and Cr most of the outer electrons extend much farther radially. J.Thewlis

548.736.3

3584. DISTORTION OF THE CRYSTALLINE LATTICE IN SOLID SOLUTIONS. V.I.Iveronova, A.P.Zvyagina and A.A.Katsnel'son.
Kristallografiya, Vol. 2, No. 3, 414-18 (1957). In Russian.

The mean square static displacement of atoms is calculated on the basis of the elastic model of solid solutions. The calculated and observed values are of approximately the same magnitude. The dependence of root mean square displacement on concentration is plotted for Fe—Co, Ni- Cr, Ni—Ti and Fe—C alloys. The dependence of critical temperature on concentration is also found for Ni- Fe alloy. R.F.S.Hearmon

548.736.3

3585. ATTEMPT TO DETERMINE ELECTRON CONFIGURATIONS IN ALUMINUM-RICH ALLOYS OF TRANSITION METALS.
P.J.Black and W.H.Taylor.
Rev. mod. Phys., Vol. 30, No. 1, 55-8 (Jan., 1958).

A discussion of the present position of the attempt to determine electron configurations by X-ray methods. It is pointed out that a study of Brillouin zones is not promising and the difficulties of electron counting from Fourier projections are outlined. These include: difficulties of resolution; the fact that the outer electrons affect only the small-angle X-ray reflections; and the unreliability of existing f-curves. J.Thewlis

548.736.4 : 539.219

3586. X-RAY INVESTIGATION OF THE SYSTEM $PbTiO_3$—$BaSnO_3$.
Yu.N.Venevtsev, A.G.Kapŷshev and Yu.V.Shumov.
Kristallografiya, Vol. 2, No. 2, 233-8 (1957). In Russian.

The cell dimensions in the system were measured as a function of composition. The phase constitution diagram is determined, and the existence of a continuous series of solid solutions is established. There are two modifications: tetragonal (ferroelectric) and cubic (paraelectric). The Curie temperature drops more rapidly with increasing $BaSnO_3$ content than it does in the system $PbTiO_3$—"$PbSnO_3$" with increasing "$PbSnO_3$" content (Abstr. 8215/1957). R.F.S.Hearmon

548.736.5

3587. STRUCTURE OF THE INTERHALOGEN COMPOUNDS. II. IODINE HEPTAFLUORIDE AT -110^0 C AND AT -145^0 C.
R.D.Burbank and F.N.Bensey, Jr.
J. chem. Phys., Vol. 27, No. 4, 981-2 (Oct., 1957).

For Pt I see Abstr. 4265 (1953). The cell is body-centred cubic above -120^0 C, with a = 6.28 A, and probably has a freely rotating molecule. Below -120^0 C it is orthorhombic, space-group Aba2. Atomic positions and temperature parameters are given for a structure obtained by refinement. A.R.Stokes

548.736.5

3588. STRUCTURE OF THE INTERHALOGEN COMPOUNDS. III. CONCLUDING NOTE ON BROMINE TRIFLUORIDE, BROMINE PENTAFLUORIDE, AND IODINE PENTAFLUORIDE.
R.D.Burbank and F.N.Bensey, Jr.
J. chem. Phys., Vol. 27, No. 4, 982-3 (Oct., 1957).

BrF_3 at -125^0 C and BrF_5 at -120^0 C are both orthorhombic, space-group $Cmc2_1$. Atomic positions are given. IF_5 at -120^0 C is monoclinic, space-group Cc or C2/c, with probably 20 molecules in the cell. A.R.Stokes

548.736.6

3589. NEW SILICATE STRUCTURES. N.V.Belov.
Kristallografiya, Vol. 2, No. 3, 366-70 (1957). In Russian.

A review of recent work, supplementing the classical determinations of Bragg. New types of chain structure are described. R.F.S.Hearmon

548.737

3590. SOME FEATURES OF THE STRUCTURE OF COLLAGEN.
N.S.Andreeva, N.G.Esipova and M.I.Millionova.
Kristallografiya, Vol. 2, No. 4, 470-4 (1957). In Russian.

X-ray evidence is obtained for the location of different chemical groups in the chain molecule of collagen. The water molecule appears to have some stabilizing effect in the structure. R.F.S.Hearmon

548.737

3591. STRUCTURE OF NAPHTHALENE AND ANTHRACENE.
J.M.Robertson.
Rev. mod. Phys., Vol. 30, No. 1, 155-8 (Jan., 1958).

A review of the history of the determination of the structure of naphthalene and anthracene by X-ray single-crystal methods. The most recent results are discussed and in particular the effect of anisotropic thermal vibrations on the Fourier maps is indicated. A difference Fourier map is shown which gives, for the first time, some picture of the distribution of the outer electrons of the carbon atoms in relation to the carbon—carbon bond directions. There seems to be some channelling of the electrons along the bonds and around the rings. There is evidence that the carbon atoms in the 9 and 10 positions of the anthracene molecule are displaced from the mean plane by a small (0.01 A) but significant amount. J.Iball

548.737

3592. CRYSTAL STRUCTURE OF BENZENE. E.G.Cox.
Rev. mod. Phys., Vol. 30, No. 1, 159-62 (Jan., 1958).

The earlier work on the determination of the structure of the benzene molecule is reviewed and the latest information obtained from a detailed and precise X-ray single-crystal study is summarized. It is shown that, if due allowance is made for anisotropic thermal vibrations, the mean carbon—carbon bond length of 1.392 A obtained from the X-ray diffraction work is in excellent agreement with the value (1.397 A) obtained from Raman spectroscopy (Abstr. 7600/1953). J.Iball

548.737 : 539.2

3593. ON THE LATTICE VIBRATIONS OF BENZENE, NAPHTHALENE AND ANTHRACENE. D.W.J.Cruikshank.
Rev. mod. Phys., Vol. 30, No. 1, 163-7 (Jan., 1958).

From the X-ray diffraction determination of the crystal structure (see the two preceding abstracts) of the three compounds, the anisotropic vibration tensors of the carbon atoms are obtained. The atomic vibration tensors are interpreted in terms of the rigid-body vibrations of the molecules and the latter are then related to the thermodynamic data for the crystals and to their low-frequency Raman spectra. The results from these three experimental techniques are in reasonably good agreement. J.Iball

548.74

3594. ELECTRON DIFFRACTION STRUCTURAL ANALYSIS.
Z.G.Pinsker and B.K.Vaĭnshteĭn.
Kristallografiya, Vol. 2, No. 4, 552-72 (1957). In Russian.

A review with 84 references. The topics dealt with include: some theoretical questions; process and characteristics of electron diffraction structure determinations; some results of structure determinations. Materials dealt with under the latter head include: $BaCl_2.H_2O$; $NiCl_2.2H_2O$; paraffin; $(NH_4)_2SiF_6$ and others. R.F.S.Hearmon

548.74

3595. THE INTENSITY OF REFLECTIONS IN ELECTRON DIFFRACTION PATTERNS (GENERAL CASE). B.K.Vaĭnshteĭn.
Kristallografiya, Vol. 2, No. 3, 340-51 (1957). In Russian.

Formulae are obtained for the scattering of electrons by specimens consisting mainly of crystallites. The formulae involve both the angular and size distribution of crystallites, and are applicable to dynamic, kinematic and intermediate scattering. Comparison with experimental data for Al, Ag and Au gives good agreement. R.F.S.Hearmon

548.74

3596. ELECTRON DIFFRACTION INVESTIGATION OF MOLYBDENUM NITRIDES.
Z.G.Pinsker, S.V.Kaverin and N.V.Troitskaya.
Kristallografiya, Vol. 2, No. 1, 179-81 (1957). In Russian.

The conditions for producing cubic Mo_2N are established. Two hexagonal phases of approximate composition MoN were also found and their cell dimensions measured. R.F.S.Hearmon

548.74

3597. DETERMINATION OF HYDROGEN POSITIONS IN CRYSTALS BY NEUTRON DIFFRACTION. G.E.Bacon.
Rev. mod. Phys., Vol. 30, No. 1, 94-5 (Jan., 1958).

Surveys the work done at Harwell during the past four or five years on the determination of hydrogen positions. Information is summarized on bond lengths and angles; on atomic vibrations; and on lines of rigidity (in α-resorcinol) and points of rigidity (in potassium hydrogen bisphenylacetate). J.Thewlis

548.74

3598. NEUTRON DIFFRACTION STUDIES OF HYDROGEN CONTAINING CRYSTALS. H.A.Levy and S.W.Peterson.
Rev. mod. Phys., Vol. 30, No. 1, 101 (Jan., 1958).

A systematic survey of the structural results for rather more than 30 substances. The latter are divided into hydrides, hydroxides, acid salts, acids, hydrates, order—disorder transitions and organic structures. No references are given. J.Thewlis

GEOPHYSICS

550.312 : 526.7

3599. THE CALIBRATION OF GRAVITY METERS BY COMPARISON WITH PENDULUMS. A.H.Cook.
Geophys. J., Vol. 1, No. 1, 18-31 (March, 1958).

The least-squares adjustment of a set of pendulum and gravity meter observations is discussed. A general formula is obtained for the dependence of the gravity meter calibration factor on the relative weights assigned to the pendulum and gravity meter observations. Further expressions for the factor are derived when the pendulum and gravity meter networks are identical and when they contain no redundant observations. Only in the latter case is the factor independent of the relative weights of the pendulum and gravity meter observations and it is suggested that, since the relative weights may be poorly determined, observations should conform to this condition. Methods of dealing with non-independent observations are considered and the application of the results to the calibration of gravity meters is discussed. A.

550.34

3600. NEW REFRACTION SEISMOGRAPH.
H.M.Mooney and R.A.Kaasa.
Rev. sci. Instrum., Vol. 29, No. 4, 290-4 (April, 1958).

A transistorized refraction seismograph has been developed based on pulse systems techniques. This results in direct visual time indications, major reductions in operating complexity, size, and weight, and the elimination of the necessity for photographic processing and the use of explosive. A 4 kc/s crystal oscillator serves as the time base. The signal passes through a gate circuit to an electronic counter; the gate is opened at the time a sound wave enters the earth and is closed at the time the sound reaches a detector on the surface. The time-distance data can be interpreted in terms of depths to subsurface layers and the nature of subsurface materials. A.

550.341 : 621.317.39

3601. AN ELECTRONIC FEEDBACK SEISMOGRAPH.
M.J.Tucker.
J. sci. Instrum., Vol. 35, No. 5, 167-71 (May, 1958).

The instrument has a nearly uniform response to ground oscillations whose periods lie between 1.5 sec and 12 sec, which is the range of particular interest for research on microseisms generated by sea waves. The seismograph consists of a 1 sec pendulum which measures ground acceleration over the range of frequencies of interest, and an electronic circuit performing double integration to give a signal proportional to ground displacement. The pendulum has negative feedback, which allows simple damping arrangements and easy absolute calibration, as well as improving stability and linearity. A horizontal-component instrument was built, but the principle should be equally applicable to measuring the vertical component. A.

550.372

3602. SOME THEORETICAL CONSIDERATIONS ON INDUCED POLARIZATION. J.H.Henkel.
Geophysics, Vol. 23, No. 2, 299-304 (April, 1958).

The phenomenon of induced polarization is treated as an induced electromotive force, leading to a polarization constant which is included in the effective resistivity of polarizable materials, such as earth materials. The transmission of sinusoidal electromagnetic waves through apolarizable earth is treated for frequencies above 30 c/s. The polarization induced in a two-layer earth is treated theoretically and calculations are presented. A.

550.38 : 523.755

3603. GEOMAGNETISM AND THE EMISSION-LINE CORONA, 1950-1953. B.Bell and H.Glazer.
Smithsonian Contrib. Astrophys., Vol. 2, No. 5, 51-107 (1957).

This statistical study of the relations between the intensity of the coronal emissions, 5303 A, 5694 A, and 6374 A, and the geomagnetic (corpuscular) index, K_p, is based on the "superimposed epoch" method of analysis, and covers a 45 month interval from February 1950 to October 1953 (a period particularly rich in solar M-region activity). Principal results are: (1) the M-regions appear at epochs of unusual weakness of 5303 A emission; (2) a previous identification of M-regions (von Kluber, 1952) with white coronal streamers is not justified; (3) the probability of onset of a geomagnetic storm is statistically enhanced when the earth is on the same side of the solar equator as is the responsible M-region; (4) central meridian passage of a solar region of high coronal density tends to correlate with low geomagnetic (K_p) activity, and vice versa. D.R.Barber

550.38 : 538.082

NUCLEAR MAGNETOMETER FOR EARTH'S TOTAL FIELD.
See Abstr. 3218

550.384 : 551.510.536

3604. GEOMAGNETIC PULSATIONS AND THE EARTH'S OUTER ATMOSPHERE. T.Obayashi and J.A.Jacobs.
Geophys. J., Vol. 1, No. 1, 53-63 (March, 1958).

Hydromagnetic oscillations of the earth's ionized outer atmosphere along the geomagnetic lines of force are considered. The observational evidence of world-wide geomagnetic pulsations yields

the distribution of ionic density in the outer atmosphere extending beyond the ionosphere. It is found that the ion density is about 10^3 per cm^3 at a distance of a few earth radii decreasing exponentially to a value of the order of 5 per cm^3 in interplanetary space. A theoretical consideration of the temperature of the outer ionosphere is also discussed. A.

ATMOSPHERE. METEOROLOGY

551.508.5 : 533.6.08

A LINEAR, UNIDIRECTIONAL ANEMOMETER OF RAPID RESPONSE. See Abstr. 2873

551.508.11

3605. CAPTIVE BALLOON REFRACTOVARIOMETER. A.L.Crozier.
Rev. sci. Instrum., Vol. 29, No. 4, 276-9 (April, 1958).

A system is described for measuring and recording rapid (3 c/s) fluctuations of refractive index, humidity (vapour pressure), and temperature using fast response thermistor beads. The system utilizes wet and dry thermistors whose changes are fed into a simple analogue computer. The accuracy of the system is 1 part in 10^7 for refractive index, about 0.1 mbar for humidity and 0.1 deg. C for temperature. Measurements can be obtained to an altitude of 5000 ft above the measuring site, with an altitude accuracy of ±50 ft under optimum weather conditions. A.

551.510.535 : 621.396.8

3606. IONOSPHERIC TRUE HEIGHT AND M.U.F. CALCULATIONS. J.O.Thomas and A.Robbins.
J. atmos. terrest. Phys., Vol. 12, No. 1, 77-9 (1958).

Certain discrepancies between the predicted and observed values of M.U.F. for oblique paths may be due to the current use of incorrect heights of reflection. The authors have shown that due allowances for the effect of the earth's magnetic field and for group retardation in the low ionosphere generally result in values of h_mF2 which are lower than those conventionally obtained, and use of the new values results in increased values of the M-factors.

G.M.Brown

551.510.535

3607. ECHOES FROM THE LOWER IONOSPHERE DURING POLAR BLACKOUTS. B.Landmark.
J. atmos. terrest. Phys., Vol. 12, No. 1, 79-80 (1958).

Brief report on h't pulse recordings made on a frequency of 2.3 Mc/s at a noise-free site in Norway. During normal conditions, weak reflections were always obtained down to heights in the range 85-75 km, but on occasions of excessive absorption these low-echoes were the first to disappear. This appears to show that the absorption effect is produced at least partly below 85 km. G.M.Brown

551.510.535 : 523.75

3608. SOLAR-FLARE EFFECT IN THE F2-LAYER OF THE IONOSPHERE. C.M.Minnis and G.H.Bazzard.
Nature (London), Vol. 181, 690-1 (March 8, 1958).

A statistical analysis of fF2 data for Singapore over the period of the great solar flare of February 23, 1956 shows that there is a fairly high probability that the increase of fF2 near the time of the flare was not random but was associated with the solar event.

G.M.Brown

551.510.535

3609. THE MESOPAUSE REGION OF THE IONOSPHERE. J.B.Gregory.
Nature (London), Vol. 181, 753-4 (March 15, 1958).

Pulse sounding h't records on a frequency of 1.75 Mc/s made at Christchurch, New Zealand, have shown the continuous existence of ionization in the height range 80-90 km. This ionization seems to be largely independent of solar control, and a theory is advanced that it consists of photo-ionized dust particles. Vertical diffusion will be such that maximum concentration may be expected in the mesopause of the atmosphere. G.M.Brown

551.510.535

3610. ON A CORRELATION BETWEEN THE ELECTRONIC DENSITY OF THE E–LAYER AND THE 500 mb SURFACE POSITION. A.Napoletano.
Nuovo Cimento Suppl. (Ser. 10), Vol. 4, No. 4, 1546-51 (1956).

The correspondence between the variations of the height of the 500 mb surface and the depth of modulation resulting from gyro-interaction in the E–layer is interpreted as indicating a positive correlation between these quantities. G.M.Brown

551.510.535

3611. SOME CRITICAL CONSIDERATIONS ON THE PARAMETERS h' AND f_0 OF THE IONOSPHERIC LAYERS. P.Dominici and F.Mariani.
Nuovo Cimento Suppl. (Ser. 10), Vol. 4, No. 4, 1589-92 (1956).

It is pointed out that physical interpretations of the commonly-measured parameters h' and f_0 may suffer from considerable ambiguities when applied to the F layer. For certain ionospheric models and conditions an effective lowering of the true height of the F2 layer as a whole may be accompanied by an increase of the minimum virtual height. Furthermore, it must be remembered that the maximum electron density derived from measurements of critical frequency refer to different heights at different times.

G.M.Brown

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.593.7

3612. SECONDARY DIFFUSION OF LIGHT DURING TOTAL SOLAR ECLIPSES. R.Cialdea.
Ann. Geofis., Vol. 10, No. 1-2, 61-70 (Jan.-April, 1957). In Italian.

To account for observations of the polarization of sky light during the eclipses of 1952 and 1954, it is necessary to consider scattering from a surface parallel to the ground in addition to contributions from the atmosphere outside the totality zone.

R.A.Newing

551.594.14

3613. RAIN SCAVENGING OF RADIOACTIVE PARTICULATE MATTER FROM THE ATMOSPHERE. S.M.Greenfield.
J. Meteorol., Vol. 14, No. 2, 115-25 (April, 1957).

On the basis of Langmuir's theory of collection efficiencies, a model is derived to explain the removal of radioactive particulate matter from the atmosphere by rain. In this connection, Langmuir's collection efficiencies are modified to take into account the density of the solid particles, and are adjusted to express the fraction removed from a vertical cylinder of constant diameter. It is assumed that electrostatic effects can be neglected in the presence of ionizing radiation. It is found that direct interaction of raindrops and particles does not account for the efficient removal of material whose diameter is below approximately 1 μ. To explain the removal of these smaller particles, a further mechanism is investigated. This consists of allowing the particles to mix with the water cloud before the rain starts. Small particles that are scavenged by cloud droplets by a process of coagulation are then placed in a position to be more efficiently removed by the rain. Fractions of a given particle size removed as a result of both these mechanisms operating are presented as a function of rainfall rate and time, and application is made to an assumed size distribution of radioactive solid particles. A.

551.594.221 : 538.561 : 621.396.821

3614. RADIO NOISE FROM LIGHTNING DISCHARGES. F.Horner and C.Clarke.
Nature (London), Vol. 181, 688-90 (March 8, 1958).

Examples are given of atmospheric wave-forms recently recorded in the high-frequency band (11 Mc/s), and also simultaneous recordings of atmospherics at 11 Mc/s and 6 kc/s. The bursts of noise in the h.f. band are often in the form of pairs of pulses with durations up to 300 msec, and they cannot be ascribed to the short-duration stepped-leader type of lightning discharge. G.M.Brown

551.594.221 : 621.316.98

3615. PRELIMINARY DISCHARGE PROCESSES IN LIGHTNING FLASHES TO GROUND. N.D.Clarence and D.J.Malan.
Quart. J. Roy. Meteorol. Soc., Vol. 83, 161-72 (April, 1957).

By using different techniques of recording the electrical effects of lightning discharges occurring at varying distances, it was possible to sort out the major components of pre-return-stroke field changes. A comparison between these field changes showed that the first return stroke of a lightning flash to ground is usually preceded by three successive and distinct discharge processes. The first, or breakdown stage, is identified from the reversal of its field change with distance as a discharge between the main negative charge centre and the positive charge centre near the base of the cloud at heights of 3.6 and 1.4 km respectively, the discharge probably just as often starting from the positive as from the negative centre. This is followed by the second stage during which the highly conducting channel then existing in the cloud is being negatively charged. The charging continues until the field in front of the channel has

become sufficiently strong to propagate a downward-moving stepped-leader breakdown streamer. Stepped leaders have been observed to precede more than 75% of all flashes to ground, though the radiation fields of most stepped leaders are so small that they can only be detected by using very high amplification. The probable mechanisms involved in the preliminary stages are discussed. A.

551.594.52

3616. HEIGHT DISTRIBUTION OF THE RED AURORAL LINE IN POLAR AURORAE. L.Harang.
Geofys. Publ., Vol. 20, No. 5, 1-9 (1958).

Luminosity curves along vertical cross-sections of auroral forms were recorded by means of a photoelectric photometer for the lines 6300, 5577 A and the band 4278 A. The intensity at 6300 A shows a considerably slower decrease with height than the green line and the violet band. The nature of the luminosity curves are demonstrated for various auroral forms. The effect is explained as due to a decrease in deactivation with height of the long-lived D-state of the O atom. A.

551.594.6 : 621.396.821

3617. STUDY OF AN APPARATUS FOR THE RECORDING OF ATMOSPHERICS. R.Benoit and J.Kernevez.
Ann. Géophys., Vol. 13, No. 4, 321-4 (1957). In French.

The theory is given of the response of a circuit to a succession of impulses, such as are produced in tropical storms, and the application to the design of a particularly simple recorder of atmospherics is considered. G.M.Brown

BIOLOGY

MEDICAL SCIENCE. HUMAN PHYSIOLOGY

611.24

3618. AN AIRFLOW INTERRUPTER FOR RESPIRATORY WORK. L.E.Mount.
J. sci. Instrum., Vol. 35, No. 3, 104-5 (March, 1958).

The interrupter was designed to give information on lung alveolar pressure. A slotted rotor moving with a uniform speed of 24 rev/min inside a slotted sleeve provides 192 interruptions/min; the sudden pressure change at the mount on interruption of the airflow is due to equilibration of pressure throughout the lung airways, and is determined mainly by alveolar pressure. A.

612

3619. PHYSICAL METHODS IN MEDICAL DIAGNOSIS. C.B.Allsopp.
Brit. J. appl. Phys., Suppl. No. 6 (Physics of non-destructive testing), S40-S47 (1957).

Reference is made to ballistocardiography, thermometry, the stethoscope, electromyography, the strain gauge and xeroradiography. It is stressed that physics as applied to medicine is, fundamentally, the same physics as is practised in non-destructive testing or in any industrial research laboratory. A.

612.843 : 537.312.5

PHOTOVOLTAIC MODEL OF THE RETINA. See Abstr. 3138

612.85 : 534.781

STEREOPHONIC LISTENING AND SPEECH INTELLIGIBILITY AGAINST VOICE BABBLE. See Abstr. 2927

612.858.7

3620. BINAURAL FUSION OF LOW- AND HIGH-FREQUENCY SOUNDS. D.M.Leakey, B.McA.Sayers and C.Cherry.
J. Acoust. Soc. Amer., Vol. 30, No. 3, 222 (March, 1958).

Experiments are reported showing that the mode of perception of binaural signals varies with spectrum; below 1000-1500 c/s threshold, the microstructure of the audio signal determines the fusion mechanism, above, the averaged envelopes of the signal. H.D.Parbrook

612.858.7

3621. DO MEETING NEURONIC FLUXES ADD INTO SUMS OR DO THEY MULTIPLY INTO PRODUCTS? M.F.Meyer.
J. Acoust. Soc. Amer., Vol. 30, No. 4, 362-3 (April, 1958).

Comment on a paper by Sayers and Cherry (Abstr. 470/1958) doubting their assumption that neural fluxes meeting in a synapse multiply rather than add before proceeding into other neurons of the brain. H.D.Parbrook

TECHNIQUE. MATERIALS

621.892

3622. THE USE OF POLYTETRAFLUOROETHYLENE AS A LUBRICANT. E.Kay and E.D.Tingle.
Brit. J. appl. Phys., Vol. 9, No. 1, 17-25 (Jan., 1958).

The use of P.T.F.E. in bulk form as a bearing is limited by its low strength and poor thermal conductivity. Experiments are described in which these difficulties are overcome by the deposition of thin films of P.T.F.E. on to metal substrates. Frictional tests under a variety of conditions show that tenacious films of low frictional coefficient and high load-carrying capacity can be prepared. These properties are considerably enhanced by using a surface phosphating treatment prior to application of the P.T.F.E. A.

669.04

3623. A COMBINED LIQUID NITROGEN CRYOSTAT, FURNACE AND LIQUID HELIUM BATH. M.J.Stubbs and M.W.Thompson.
J. sci. Instrum., Vol. 35, No. 2, 68-9 (Feb., 1958).

An appratus is described in which a liquid nitrogen cryostat and a furnace were associated for annealing specimens at temperatures between -196° and 200°C. Provision was made for transferring the specimens to liquid He without removing them from the apparatus. A.

669.041 : 537.311.3.08 : 621.365.41

3624. A VACUUM FURNACE FOR ELECTRICAL CONDUCTION STUDIES UP TO 2000°C. W.E.Danforth and H.Bleecher.
J. Franklin Inst., Vol. 265, No. 4, 303-8 (April, 1958).

Constructional details and performance characteristics of a vacuum furnace, suitable for studies of properties of matter and operable to 2000°C are given. By virtue of a relatively high-impedance design, the unit may be operated on d.c. thereby avoiding troublesome a.c. pick-up in measuring circuits. The volume of the hot zone is approximately 3 cm diameter and 12 cm long; power required for 2000°C is approximately 6 kW. A.

669.041

3625. A LABORATORY ELECTRON BOMBARDMENT FURNACE. P.G.England and H.N.Jones.
J. sci. Instrum., Vol. 35, No. 2, 66-8 (Feb., 1958).

A furnace is described in which small ingots (approximately $3 \times \frac{1}{2} \times \frac{1}{2}$ in) of metal can be melted on a water-cooled Cu hearth under a high vacuum (less than 10^{-4} mm Hg). The charge is heated by bombardment with a stream of electrons emitted from a W filament suspended above the charge. A d.c. potential of up to 10 kV applied between the hearth and the filament is used to accelerate the electrons. The use of such a furnace for purifying Nb and melting high purity U is described. A.

669.054 : 537.311.33

3626. ZONE PURIFICATION OF SILICON. E.A.Taft and F.H.Horn.
J. Electrochem. Soc., Vol. 105, No. 2, 81-3 (Feb., 1958).

High purity Si was obtained using thin-walled quartz boats. Data are presented which show that improved life-time and more uniform electrical resistivity result from the zone purification of commercially available Si. A.

669.054 : 537.311.33

ZONE MELTING AND CRYSTAL PULLING EXPERIMENTS WITH AlSb. See Abstr. 3102

PHOTOGRAPHY

771.35 : 535.81

3627. THE FLASH PHOTOGRAPHY OF A DEEP FIELD OF VIEW. F.de S.Barros, D.M.Binnie and B.D.Hyams.
J. sci. Instrum., Vol. 35, No. 4, 129-31 (April, 1958).

An optical arrangement for the photography of deep fields of view is described. It involves the illumination of successive strips of the object space and the use of a weak auxiliary lens of variable focal length. The variable lens refocuses in about 2 msec. A.

LIST OF JOURNALS

The following list supplements the List of Journals published with the June number of Volume 60 (1957) and the Supplement published with the Index to the same volume. Reprints of the List of Journals and of the Supplement can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

J. molecular Spectrosc.	Journal of Molecular Spectroscopy. Academic Press, 111 Fifth Avenue, New York 3, N.Y.
Proc. Nat. Electronics Conf.	Proceedings of the National Electronics Conference. 84 East Randolph Street, Chicago 1, Illinois.
Radiation Research	Radiation Research The Radiation Research Society. Publishers: Academic Press, 111 Fifth Avenue, New York 3, N.Y.
Ukrayin. fiz. Zh. Dodatok	Dodatok Do Ukrayins'koho Fizȳchnoho Zhurnalu. [Supplement to Ukrayins'kiĭ Fizȳchnȳĭ Zhurnal] Akademiya Nauk Ukrayins'koyi RSR, Vladimirskaya 58a, Kiev.

NEW JOURNALS

Elteknik	Elteknik Svenska Elektroingenjörers Riksförening, Brunkebergstorg 20, Stockholm. Monthly. Vol. 1, No. 1 dated Jan., 1958.
Proc. Iraqi Sci. Socs	Proceedings of the Iraqi Scientific Societies Baghdad. Subscription address: Dr. Abdul K. Khudairi, College of Sciences, Adhamia, Iraq. Vol. 1, dated 1957.
Wear	Wear = Usure = Verschleiss Elsevier Publishing Co., Spuistraat 112, Amsterdam-C. Subscriptions for the British Commonwealth (except Canada) to: Cleaver-Hume Press, 31 Wright's Lane, Kensington, London, W.8. Six issues to the volume. Vol. 1, No. 1 dated Aug., 1957.

NOTES

Portugal. Math.	Portugaliae Mathematica. Address changed to: Rua Nova Da Trindade 1, 5.°-S, Lisbon.
Ukrayin. fiz. Zh.	Ukrayins'kiĭ Fizȳchnyĭ Zhurnal. New transliteration to be used for the journal formerly referenced as: Ukraïn. fiz. Zh. [Ukraïns'kii Fizichniĭ Zhurnal].

ERRATA

Abstr. 5264, 5546, 6395, 6476, 6564 (1957), journal reference : for "Vol. 239" read "Vol. 238".
Abstr. 774 (1958) line 2 : for "L.Spitzer" read "L.Spitzer, Jr."
Abstr. 2470 (1958) line 2 : for "R.Rȳndin" read "R.M.Rȳndin".
Abstr. 2680 (1958) line 3 : for "P.A.Kurov" read "G.A.Kurov".
Abstr. 2684 (1958) line 4 : for "58-68" read "57-68".

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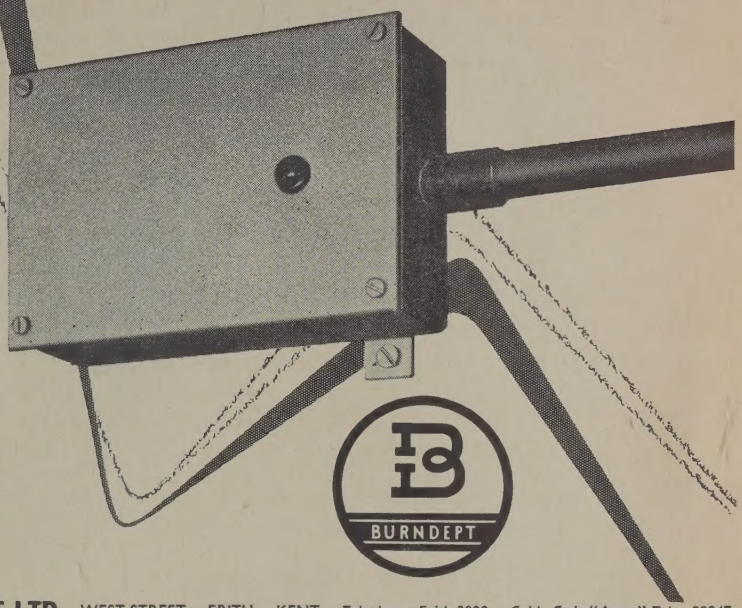

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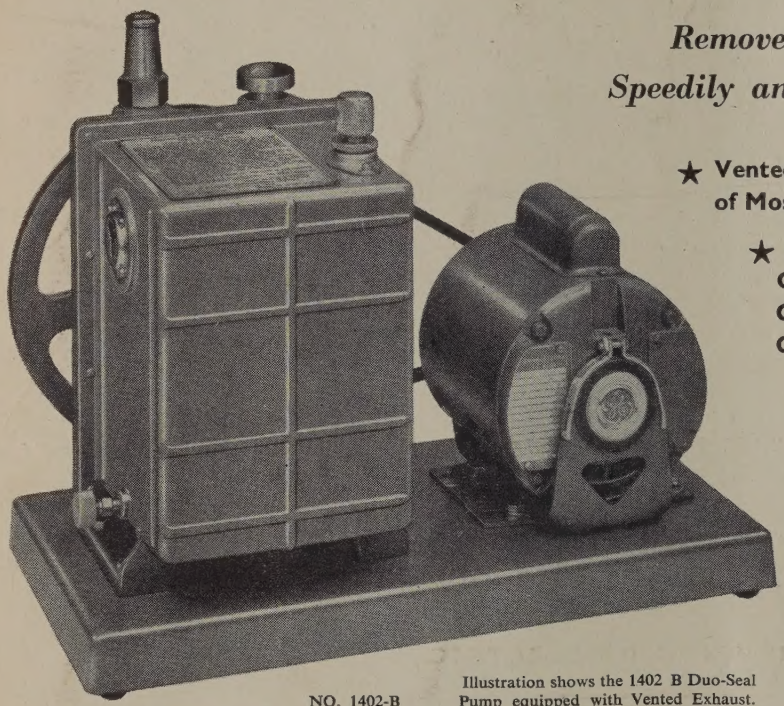

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